SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1926.

GENERAL PHYSICS.

2748. *Surface-Tension Measurement.* **S. G. Subramanyam.** (Phys. Rev. 27. pp. 632–633, May, 1926.)—A modification of Lord Rayleigh's stroboscopic method of measuring the velocity of ripples on the surface of liquids is described. A single, electromagnetically driven tuning-fork is used to generate the ripples and at the same time to drive by means of a Rayleigh synchronous motor a stroboscopic disc having as many slots as there are teeth on the motor armature. When the liquid surface is viewed through the disc the ripples appear stationary and their wavelength may be measured. A sample set of data is presented giving a value of 73·7 dynes/cm. for the surface-tension of water at 30° C. G. A. S.

2749. *Ring Method of Surface-Tension Measurement.* **J. M. Johlin.** (Science, 64. pp. 93–94, July 23, 1926.)—Calls attention to the fact that dimensions of the ring and the thickness of the wire affect the results to as much as 3 %; also criticises the claim that "absolute" values of the surface-tension of colloidal solutions have been obtained, as the value changes with time in a way not yet understood and does not readily reach an equilibrium value. W. G. B.

2750. *Diffusion of Fluid issuing from a Small Aperture. Convection Currents in a Rectangular Vessel. Formation of Whirl by Ascending Currents.* **T. Terada** and **K. Hattori.** (Tôkyô Univ. Aeronaut. Research Inst. Report, 2. pp. 87–112, May, 1926. In English.)—Describes the results of some experiments carried out with the object of determining the motion of fluids under certain conditions as detailed in the title above. The work was carried out by means of coloured liquids in a glass vessel or liquids containing aluminium powder in suspension. Photographs of the latter are given to show the stream-lines observed under certain conditions. J. W. T. W.

2751. *Lines of Constant Velocity in Fluid Flow.* **C. Wieselsberger.** (Tôkyô Univ. Aeronaut. Research Inst. Report, 2. pp. 115–125, June, 1926. In German.)—A theoretical treatment of the problem of finding the lines of constant velocity of flow in the stream past a body of given form. The lines are calculated for the cases of a cylinder and a wing section at different angles of aspect. J. W. T. W.

2752. *Mechanical Calculation of Elastic Systems.* **O. Gottschalk** (Frank. Inst., J. 202. pp. 61–87, July, 1926.)—Statics generally has been treated as a mathematical science, expressing in abstract and complicated formulæ and equations the behaviour of forces and works which act on different structures, employing such formulæ with purely mathematical procedures, and finally interpreting in terms of resistance the results thus obtained. The author, however, has found it possible to eliminate all these accustomed complications, which obscure rather than clarify the statical behaviour, by working directly with elastic lines which correspond to the forces to be determined and making use of an appropriate machine. The invention is termed the "Gottschalk Continostat," which is described and applied in the present paper, and which permits automatically and instantaneously the determination of the conditions and exigencies of resistance of any structure. §§ 1 and 2 consider influence lines; § 3 deals with trigonometric relations of rotation; § 4 investigates the continuous beam; § 5 treats of portals, and § 6 of trusses without diagonals; § 7 discusses precision of results, and § 8 checking results through actual deformations; the utility of the method is emphasised in § 9. The paper contains 25 diagrams and is replete with data. H. H. Ho.

2753. *Gas Currents in Tubes and the Air Resistance of Globes.* **A. Knodel.** (Ann. d. Physik, 80. 6. pp. 533–587, July 24, 1926.)—The current lines are made visible by means of thin streaks of sal-ammoniac in all the tubes along the whole of their length and over the whole of their cross-section, and are seen to be strictly parallel to the axis. When a small globe is introduced into such a stream an alteration of the current lines in its neighbourhood takes place. When the quantity flowing through is below a critical value, the velocity distribution over the cross-section of the tube in narrow tubes, up to about 0·5-cm. radius, is shown through a quadratic parabola. In such cases the connection between pressure and volume passing through follows the Poiseuille law. With a tube radius of about 2 cm. the velocity distribution is shown with good approximation by a cubic parabola. The air resistance of the globes investigated is given by the Becker formula $W = k\eta rv + b\delta r^2v^2$. The factor b is independent of the radius of the globe and the velocity and is equal to 1. The friction factor k, independent of the radius of the globe, increases with increasing velocity from the value 6π of the hydrodynamic equation up to a limiting value of about double that amount when a velocity of 40 cm./sec. is reached. A. E. G.

2754. *Statistical Mechanics.* **V. Burslan.** (Zeits. f. Physik, 38. 1–2. pp. 116–118, 1926.)—Krutkow's appeal [see Abstract 1732 (1926)] to time-averages in his generalisation of statistical mechanics can be replaced by a purely statistical Gibbs or Boltzmann scheme. A. D.

2755. *Measurement of the Compressibility of the Alkali Halides.* **J. C. Slater.** (Am. Acad., Proc. 61. pp. 135–150, April, 1926.)—A previous paper by the same author [see Abstract 1669 (1924)] dealt chiefly with theoretical deductions from data obtained on the compressibility of some of the alkali halides. In the present paper experimental details of the same investigation are given. Single large crystals of the salts were made by crystallising from the molten salt at high temperature, the samples used being cylinders $\frac{3}{16}$ in. diameter and $\frac{1}{2}$ in. long. The method of measurement was that used by Bridgman [see Abstract 1014 (1923)], and measurements were made every 1000 atmospheres up to 12,000 and at temperatures 30° and 75° C. Results are given of the compressibility, the change of compressibility with pressure, and the change of compressibility with temperature for the following salts; LiF, LiCl, LiBr, NaCl, NaBr, KF, KCl, KBr, KI, RbBr, RbI. T. B.

2756. *The Jacobian Transformations of Quantum Mechanics.* **F. London.** (Zeits. f. Physik, 37. 12. pp. 915–925, 1926.)—The hitherto formal expression of quantum mechanics, as found in the work of Heisenberg, Born, Jordan, and Dirac [see Abstract 1229 (1926)], is limited to the treatment by libration coordinates, and stands in characteristic contrast to the classical quantum theory, which, with its distinctive angular variables, was mainly a theory of rotation. The present paper deals with the application of the Jacobian canonical transformations to quantum mechanics, and it is shown that the transformation to angular variables affords a contribution to the solution of chief axial problems and to the determination of intensities. A remarkable connection is found between the non-observable rotational frequencies and the intermittent frequencies. The paper is mathematical throughout. A postscript refers to a forthcoming paper by Wentzel, who has approached the problem *via* Sommerfeld's method of complex integration. This, however, does not lead to an explicit statement of the canonical transformation and so also does not determine the intensities. H. H. Ho.

2757. *Transfer of Energy from Electrons to Atoms.* **F. Zwicky.** (Nat. Acad. Sci., Proc. 12. pp. 466–470, July, 1926.)—The relations of the energy transfer are worked out on ordinary mechanical principles for the following model. A linear oscillator has its axis normal to the unperturbed rectilinear path of a passing electron. At $t = -\infty$ the oscillator is at rest and at $t = 0$ the passing electron is opposite the oscillator. It is found that as the electron approaches, the displacement of the oscillator steadily increases to a certain value. As the electron recedes, however, the displacement is the sum of two terms, the first steadily decreasing and corresponding to the approach displacement, the second an oscillation at the frequency of the oscillator. The energy bound up with this oscillation and which has been gained from the electron is evaluated. The magnitude of the energy transfer turns out to be much greater than that found experimentally for the elastic impact of electrons with atoms. There is thus a complete contradiction to the experimental facts—a contradiction which still persists in Bohr's formulation of the quantum theory. W. S. S.

2758. *Quantum Theory and the Behaviour of Slow Electrons in Gases.* **F. Zwicky.** (Nat. Acad. Sci., Proc. 12. pp. 461–466, July, 1926.)—The results of experiments on the deflection of slow electrons in passing through gases are discussed in relation to the possibility of detecting the true revolution frequencies of the orbital electrons in the atoms of the gas. The effective area $q(\phi)$ of an atom for electrons of velocity v (*i.e.* the area within which an electron must pass in order to suffer a deflection greater than ϕ) is found to vary with v in one of three different ways. A formula is quoted (proof to be published separately) which enables the effective area for various types of atoms to be calculated. For simple polarisable atoms in which the deflected electron induces a dipole, the formula indicates that the product *qv* is proportional to the molar refractivity. This is confirmed by recent experiments on H_2 and the vapours of Zn, Cd and Hg. Other atoms must be assumed asymmetric before the advent of the electron and are to be treated as rotating dipoles. The rare gases come into this category. It is assumed that when the velocity of the deflected electron divided by the distance of closest approach is comparable with the rotation frequency of the atomic dipole, *q* will be decreased, giving a maximum in the *q-v* curve. Such maxima are, in fact, observed. According to the new quantum theory, however, only the transition frequencies can be detected experimentally. A table is therefore given showing the ratio of the velocity at which *q* is a maximum, to the first resonance potential, for the atoms of Ne, Ar, Kr and Xe. The ratio is approximately constant. The inference seems to be that Bohr's system of "virtual" oscillators has a real existence and acts mechanically on passing electrons. W. S. S.

2759. *The Forces between Atoms and Ions.* **J. E. Lennard-Jones and B. M. Dent.** (Roy. Soc., Proc. 112. pp. 230–234, Aug. 3, 1926.)—A note supplementary to a recent paper [see Abstract 917 (1926)] gives a complete table of forces between the monovalent and divalent ions of the inert gas type and between the inert gases themselves. The method used is that of the previous paper, employing the published data on ionic refractivities. H. N. A.

2760. *Electromagnetic Mass and Momentum of a Spinning Electron.* **G. Breit.** (Nat. Acad. Sci., Proc. 12. pp. 451–461, July, 1926.)—The electron model employed consists of a rigid surface distribution of charge. The masses of the electron for accelerations respectively perpendicular and parallel to the axis of rotation are evaluated. If the magnetic moment μ_0 is put equal to $(eh)/(4\pi mc)$ an approximate value of the radius equal to $4 \cdot 2 \,.\, 10^{-12}$ cm. is obtained. The corresponding maximum peripheral velocity is $20c$. The magnetic attraction between the two hemispheres formed by a plane normal to the axis of rotation is shown to be about twenty times the electric repulsion. The relation between *h, e, c* and *m*, necessary to make the electron stable and bring its maximum peripheral velocity to the value *c*, is derived. A calculation of the total angular momentum of the field indicates that this quantity exceeds $h/2\mu$ by a factor of about 20. The effect on the motion of the model of magnetic and electric fields is considered and a tentative quantitative treatment of the energies involved in the Zeeman-effect and in "relativity" doublets is advanced. W. S. S.

2761. *Rotating Electrons.* **F. Rasetti and E. Fermi.** (N. Cimento, 2. pp. 226–235, May, 1926.)—The hypothesis of Uhlenbeck and Goudsmit (see Naturw. 13. p. 953, 1925 and Nature, 117. pp. 264–265, Feb. 20, 1926) that the electron has an energy of rotation is examined. It is shown that while many apparent anomalies are explained, the hypothesis involves attributing to the electron an apparently inadmissibly large size. A. D.

2762. *Polarisation of a Medium and its Molecular Structure. Electric Moments of Dihalogenated Derivatives of Benzene.* **J. Errera.** (Comptes

Rendus, 182. pp. 1623–1625, June 28, 1926.)—The electric moments of dihalogenated derivatives of benzene diminish in passing from the chloro- through the bromo- to the iodo-derivatives, in agreement with the diminishing electro-negative character of the halogens. The ortho-isomerides have higher moments than the meta-compounds, whilst the para-isomerides have no moments; thus parallelism exists between the cis- and ortho-compounds and between trans- and para-compounds. The moments of ethylenic compounds are inferior to those of benzenic compounds. The degree of association in the pure liquid (1) is very great for the ortho-compounds, less for the meta-compounds, and zero for the para-compounds, and (2) is greater for an ethylene cis-compound than for the corresponding ortho-derivative. The difference which exists between the ratio of the moment of the ortho-compound to that of the meta-compound for the dichloro- and di-iodo-benzenes indicates increasing deformation of the benzene nucleus as the atomic weight of the substituent increases. The absence of electric moment with para-compounds disagrees with the polar benzene theory. T. H. P.

2763. *Electric Structure of Molecules. Anisotropic Fluids.* **E. Bauer.** (Comptes Rendus, 182. pp. 1541–1544, June 21, 1926.)—The fundamental hypotheses of the theory proposed by Born to account for the properties of anisotropic liquids are enumerated and discussed in relation to the experimental confirmation found in the results obtained by various investigators. A. B. C. L.

2764. *The Differentiation between Ionic and Atomic Lattices by Means of X-Ray Spectroscopy.* **A. E. v. Arkel.** (Zeits. f. Physik, 37. 9. pp. 672–675, 1926.)—It is well known that the lattices of such compounds as KCl, MgO are constructed of ions, and Ott [see Abstract 1393 (1924)] believed that it is possible to conclude with certainty that that of aluminium nitride, for instance, is constructed of atoms. Becker came to similar conclusions with respect to TiN. In the calculation of intensities many simplifications are introduced, and one is usually content to assume that for neighbouring lines only the influence of the structure factor is of importance. Thus it is usual to assume that the scattering is proportional to the number of electrons in the atom and that these electrons remain at rest in the centre of gravity of the atom. This neglect of electronic spacing leads to incorrect results for light elements. Considering the case of TiN (having the rock-salt structure), and making the usual assumptions, best agreement with observed intensities is obtained assuming an ionic lattice. However, taking into account the spatial arrangement of the electronic shells, an entirely different result is obtained. Thus for neighbouring lines (311) and (222) the ratio is the same as for an atomic lattice. For AlN and NaF similar conclusions are reached. Thus for small angles of reflection the extension in space of the atoms has a small effect, and the lattices behave as ionic lattices, but with increasing angle the interference pattern alters to that to be expected from an atomic lattice, the line (311), for instance, having a measurable intensity for NaF and MgO, though (111) vanishes. Since the scattering power of an atom is a function of the angles of reflection, we cannot exactly describe all intensities using the same value of the parameter for crystals in which this unknown parameter still persists. W. V. M.

2765. *A Mathematical Study of Crystal Symmetry.* **A. F. Rogers.** (Am. Acad., Proc. 61. pp. 161–203, June, 1926.)—There is a lack of uniformity in the manner of expressing the symmetry of crystals; the paper presents a mathematical treatment of the whole subject, applying the theory of groups. The symmetry operations possible in crystals are identical operation, rotations about an axis, reflection in a plane, inversion about the centre, rotatory-reflections or rotoflections and rotatory-inversions or rotoversions; all of these symmetry operations are represented by faces of the general form in crystals of either beryl (dihexagonal bipyramidal class) or garnet (hexoctahedral class). Counting the various positions in a crystal of axes, planes, rotatory reflection axes and rotatory inversion axes of symmetry, there are in all sixty-four symmetry operations found in crystals. Both rotatory-inversions and rotatory-reflections must be used as symmetry operations. The possible elements of symmetry are the axes of symmetry, plane of symmetry, centre of symmetry, rotatory-reflection axis plane, rotatory-inversion axis centre. A table is given of the thirty-two crystal classes with their sub-groups.
H. N. A.

2766. *Radioactive and Non-radioactive Isotopes.* **T. Hori.** (Kyoto Coll. Sci., Mem. 9. pp. 371–378, July, 1926. In English.)—Considers the possibility of the formation of the various isotopes of the known elements by disintegration processes of the same nature as those observed in the radioactive elements. Down to Cu a scheme can be worked out which accounts for the existing non-isotopic elements and isotopes, when the atomic masses are given by $4n$ and $4n \times 2$, the transformation being in one case a continuation of the U-series and in the other of the Th-series. The other two possible series are also worked out, $4n + 1$ and $4n + 3$, and a graph is constructed showing the probable lines of descent. It is necessary to assume that certain transformations produced unstable elements, which have disappeared. H. N. A.

2767. *Quantum Theory of Vibration-Rotation Bands.* **J. R. Oppenheimer.** (Cambridge Phil. Soc., Proc. 23. pp. 327–335, July, 1926.)—The theory of the vibration-rotation spectrum of a diatomic molecule given by Brillouin [see Abstract 1760 (1926)], using a modified form of Heisenberg's quantum mechanics, is criticised. A treatment of the problem by means of Dirac's form of quantum mechanics is given in detail. The absorption frequencies obtained are found to differ slightly from those given by the classical quantum theory, although not sufficiently to render experimental detection practicable. The corresponding energy differences would, however, give an appreciable term in the specific heats. The intensities are calculated, and are a little different from those computed by Kemble. In an addendum it is noted that Schrödinger, using his method of characteristics, has obtained energy terms leading to the frequencies given here. Mensing's treatment of the same problem [see Abstract 2021 (1926)] is criticised in the derivation of the intensities of the overtones. W. S. S.

2768. *Solution of the Problem of the Simple Oscillator by a Combination of the Schrödinger and the Lanczos Theories.* **C. Eckart.** (Nat. Acad. Sci., Proc. 12. pp. 473–476, July, 1926.)—Schrödinger has recently published a new quantum condition in form of a variation principle [see

Abstract 1512 (1926)]. This leads to a differential equation for a certain function analogous to the Hamilton-Jacobi S, which possesses relatively simple solutions for certain discrete values of the energy constant. Schrödinger has shown that in the case of hydrogen these discrete values are those of the Bohr levels, provided that the single arbitrary constant of his theory (which must be introduced because of dimensional considerations) is given the value $h/2\pi$. The purpose of this paper is to show, in a purely formal way, that the Schrödinger equation must be the basis for the Born, Jordan and Heisenberg matrix calculus. This is most readily accomplished by using the Lanczos modification of the latter. Only a solution of the special problem of the simple linear oscillator is attempted, but the results are capable of immediate generalisation. The Lanczos quantum theory [see Abstract 1230 (1926)] requires a set of orthogonal functions by means of which the matrices of Born and Jordan are to be determined, but so far no problems have been solved by means of the theory, primarily because the determination of the orthogonal functions has been impossible. The Schrödinger quantum principle leads directly to a set of orthogonal functions, and the author now shows that if these are interpreted as the functions entering into the Lanczos theory, the matrices of the Born-Jordan theory are readily obtained. H. H. Ho.

2769. *Note on G. Szivessy's Paper entitled "The Born Dipole Theory of Anisotropic Liquids."* **W. Kast.** (Zeits. f. Physik, 37. 3. p. 233, 1926.)—Although the author's experiments on the magnetic orientation of an anisotropic melt have failed to establish free electric charges, nevertheless they are in complete agreement with the consequences which Ornstein deduced from previous experiments on the dielectric anisotropy of anisotropic liquids [see Abstract 965 (1924)], and in contradiction with Szivessy's conclusions [see Abstract 50 (1926)] against the dipole nature of anisotropic liquids. The anisotropic melts of azoxyanisole and azoxyphenetole are found to contain as many ions as distilled water, and these are now opined to compensate the dipoles in the boundary surface, thereby preventing the actual observation of free electric charges. H. H. Ho.

2770. *Reply to Kast's Criticism of the Author's Paper on "The Born Dipole Theory of Anisotropic Liquids.* **G. Szivessy.** (Zeits. f. Physik, 38. 1–2. pp. 159–160, 1926.)—The author has shown previously [see Abstract 50 (1926)] that an anisotropic liquid placed in a magnetic field exhibits no electric charge on the boundary surface against the field direction, when, according to Born's dipole theory, such a charge must exist. Kast has opined this negative result not to invalidate the dipole theory, since anisotropic liquids possess a certain conductivity. Kast's arguments [see preceding abstract] and experimental data are carefully examined, but the author adheres to his former conclusion in favour of Ornstein's theory and against that of Born. H. H. Ho.

2771. *Researches on the Detection of Electrodynamic Effects of the Earth's Motion at Great Heights. Part II.* **R. Tomaschek.** (Ann. d. Physik, 80. 5. pp. 509–514, July 13, 1926.)—The attempt described in Part I [see Abstract 925 (1926)] to detect at great heights a torque on a charged condenser due to a possible motion relative to the ether was repeated after the lapse of six months, when the earth's orbital velocity and the velocity of the whole solar system reinforced each other to a greater extent. The apparatus had in the interval been improved, a larger condenser and more efficient electrostatic screening being employed. The experiments were made at Jungfraujoch at a height of 3450 metres in the early weeks of April, 1926. As before, no appreciable effect was obtained, although a relative motion of 500 m./sec. would have been demonstrable. Miller's interference experiments at a height of 1750 m. indicated an effect corresponding to a relative velocity of 9 km./sec. An optical effect of the first order was also sought, corresponding to a difference of light times for passage through a medium of high refractive index, in the direction of the ether stream and in the opposite direction. With a medium of high dispersion, a displacement of the interference bands arising from the change of the drag-coefficient with wave-length was anticipated. No such change could be observed using CS_2 as the medium. W. S. S.

2772. *The Einstein Addition Theorem of Velocities.* **A. Popow.** (Zeits. f. Physik, 38. 1–2. pp. 157–158, 1926.)—In this brief mathematical note the author proves the Einstein theorem, without recourse to the relativity theory, for the case where the velocities are parallel to each other. H. H. Ho.

2773. *The Complex Lines Element.* **E. Reichenbächer.** (Zeits. f. Physik, 38. 4–5. pp. 329–345, 1926.)—In the author's previous paper on the mechanical equations in the electromagnetic field [see Abstract 30 (1926)] it was proposed to regard the effect-differential, $dw = \frac{e}{m}\phi_k dx^k + \sqrt{g_{\mu\nu}dx^\mu dx^\nu}$, as the lines element and its coefficients ϕ_k and $g_{\mu\nu}$ as fundamental units of the metric. Four of the scalars formed were accepted as arguments in the world function of the effect-integral by whose variation the field equations of electricity and gravitation are obtained by known methods. It is now shown that for the Weyl theory, from which the present work is only distinguished essentially in the interpretation of the linear differential form $\phi_k \, . \, dx^k$, the form of the field equations mainly depends on the nature of the scalars entering into the world function and only slightly on the structure of this function. The field equations have been further derived for some special cases and solved for the simplest of these, whereby a connection has been established with the Einstein-Schwarzschild solution of the single-body problem. H. H. Ho.

2774. *Doppler's Principle.* **T. Takeuchi.** (Phys. Math. Soc. Japan, Proc. 8. pp. 122–125, May, 1926. In English.)—The significance of relativity in the discussion of Doppler's principle is briefly referred to, more especially in connection with the attribution of the Doppler-effect to a relativistic spectrum shift and *vice versa.* [See Abstract 51 (1926).] J. S. G. T.

2775. *A Possible Selective Field in Space-Time.* **K. Hattori.** (Phys. Math. Soc. Japan, Proc. 8. pp. 126–131, May, 1926. In English.)—A selective field is one which produces no effect upon an actual particle. A particle responding to a selective field is described as charged. The tracks of charged particles and the tensor equations of the field are determined. These latter are exactly the same as those of the electromagnetic field. J. S. G. T.

2776. *The Problem of Relativity in Reference to Several Bodies.* **R. Hargreaves.** (Cambridge Phil. Soc., Proc. 23. pp. 191–197, July, 1926.)—From the dynamical point of view, a marked characteristic of Einstein's quadratic form for the line element consists in the fact that by ignoration of t it affords the potential terms of dynamics. It is assumed that this should hold also for several bodies, so that the content of a modified coefficient of dt^2 is determined by the potential. By analogy with the case of two bodies, compensatory terms varying as dr^2 are introduced into the quadratic form, and then the coefficients are determined by the principle that the determinant of the expression remains unchanged in value. In the case of the problem of three bodies, the determinant depends solely on the mutual distances between the bodies, and it is suggested that this may be the case with several bodies. J. S. G. T.

2777. *Relativity in Connection with Axial Rotation.* **R. Hargreaves.** (Cambridge Phil. Soc., Proc. 23. pp. 198–202, July, 1926.)—Discrepancies in the application of Einstein's form of the line element to the problem of the rotating disc are briefly referred to. The consideration of these, together with the need of recognising acceleration as a primary feature in dealing with axial rotation, leads to the formulation required to give proper significance to the part played by the covariant derivatives B (in Einstein's notation). A complete scheme of geodesy for a rotating disc is furnished by reference to the spherical trigonometry of a hemisphere of radius V/ω. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

2778. *Climatic Changes during Geological Times.* **C. E. P. Brooks.** (Nature, 118. pp. 15–17, July 3, and pp. 53–55, July 10, 1926.)—The author first reviews the main climatic conditions associated with the successive geological deposits from the earliest times on the earth. These show an alternation of glacial and genial periods, the former being associated with mountain-building and the latter with warmth and rest, the cycle of changes occurring approximately in 250,000,000 years. The present climatic belts consist of an equatorial rain-forest belt, two subtropical dry belts, two temperate rain belts and two polar glacial caps. In turn these several conditions have existed over various parts of the earth, and thus the positions of the poles must have changed. A general statement is given of Wegener's theory of continental drift and the various objections raised to it by Jeffreys and others. The astronomical theory of climatic changes is next examined and its differences from the geological theory shown, while the possible effects of the absorption of long wave radiation by CO_2 and of the reversal of ocean currents are investigated. The author inclines to the geographical changes being the main cause of climatic changes, and examines in detail the formation and disappearance of floating sea ice and of an ice cap. [See also Abstract 1835 (1925).] R. S. R.

2779. *The Meteorological Conditions during the Glaciation of the Present Tropics, being Some Remarks on the Climatological Basis of*

Wegener's Theory of Continental Drift. **C. E. P. Brooks.** (Roy. Meteorolog. Soc., J. 52. pp. 251–260; Disc., 260–262, July, 1926.)—An outline is given of Wegener's theory of continental drift and the resulting positions of the poles on the earth's surface, together with the objections to this theory arising from the study of glacial deposits in the United States of America. A reconstruction is then made of the geography of the upper carboniferous period, giving three small continents—Nearctis, North Atlantis and Angaraland—in the northern hemisphere, with a central sea to the south separating them from the continent of Gondwanaland. The topographical features of these areas are considered and the main sea currents around them. Finally the main distribution of high and low pressure systems is considered and the possibilities of forming an ice cap and glaciers in Gondwanaland and of glaciers in U.S.A. **G. C. Simpson** considers that the idea of Gondwanaland is wrong from views of isostasy and that the existing evidence from India and Tibet is against the idea of glaciers coming anywhere near to sea-level. The author replies to these arguments. R. S. R.

2780. *The Driest and Wettest Years at Individual Stations in the British Isles,* 1868 *to* 1924. **J. Glasspoole.** (Roy. Meteorolog. Soc., J. 52. pp. 237–248; Disc., 248–249, July, 1926.)—For the purpose of the paper 300 long records of rainfall were available, but only such as appeared to be homogeneous were utilised. The method consisted essentially of examining the records in relation to those from neighbouring stations on three series of maps, showing as a percentage of the average 1881 to 1915 (*a*) the rainfall of each year, (*b*) of each ten years, and (*c*) of each thirty-five years in the whole period under discussion. Tables and maps provide for any part of the British Isles (*a*) the driest year and its rainfall, (*b*) the wettest year and its rainfall, (*c*) the percentage fall in the driest year, and (*d*) the percentage fall in the wettest year. The driest years for most parts of the British Isles were 1887 and 1921, while the wettest year was 1872, particularly in England and Wales, and next to this 1903. R. S. R.

2781. *The Variation of Pressure from Month to Month in the Region of the British Isles.* **C. E. P. Brooks.** (Roy. Meteorolog. Soc., J. 52. pp. 263–275; Disc., 275–276, July, 1926.)—Charts have been prepared to demonstrate the deviation from normal of monthly means of pressure over the northern hemisphere during the period 1873–1925. It is shown that the centres of maximum pressure deviation on consecutive charts frequently indicate successive positions of the same centre. The travel of these centres is analogous with the motion of depressions and anticyclones, and generally takes place in an easterly direction; it appears probable that the paths followed by centres of excess often represent the paths of large anticyclones, and that tracks of centres of deficit may represent foci of cyclonic activity.

Centres of excess have an average life of about three months, and their most favoured track passes from Alaska, across the United States, Azores, Britain, and Scandinavia to northern Russia or the Kara Sea; other tracks extend from Greenland to the British Isles and from South-Western Europe into Western Siberia. The paths followed by centres of deficit are less regular; groups of tracks are indicated which spread out between E.N.E. and E.S.E. from the East Coast of North

America, and from south-west of the British Isles across Scandinavia. Easterly movements, although still predominating with centres of deficit, are not as well marked as with centres of excess. A. W. L.

2782. *Meteors and the Constitution of the Upper Air.* **F. A. Lindemann.** (Nature, 118. pp. 195–198, Aug. 7, 1926.)—The author reviews the information concerning conditions in the atmosphere at great heights, which has been gained from a study of meteors [see Abstracts 1069 and 1078 (1923)], and further evidence in favour of the assumption that the atmospheric temperature increases to about 300° abs. at heights above about 50 km. is adduced from (1) the occurrence around sources of sound of alternate zones of audibility and silence; (2) the Heaviside layer, which lies at a height ranging from 50 km. at sunset to about 80 km. at sunrise; (3) theoretical consideration of the active gases present in the upper atmosphere whose radiative equilibrium temperatures govern the air-temperature in the stratosphere. A. W. L.

2783. *High-Frequency Rays of Cosmic Origin—Remarks on the Work of R. A. Millikan and J. S. Bowen.* **W. Kolhörster.** (Zeits. f. Physik, 38. 4–5. pp. 404–406, 1926. Ann. d. Physik, 80. 6. pp. 621–628, July 24, 1926.)—In the first of these papers the author criticises Millikan's deductions from the records of four pilot balloon ascents, "in only one of which temperature effects on the mean value of the penetrating radiation at an uncertain height between 5–15·4–5 km. could be estimated." Against such a single uncertain observation the author offers his own observations consisting of 1000 well-defined and accurate mean values of the penetrating radiation determined in 1913–1914 and in 1925.

The second paper offers further criticism of a similar nature. A. B. W.

ASTRO-PHYSICS.

2784. *A New Proof of the Variability of the Sun, based on Mount Wilson Observations.* **C. G. Abbot.** (Monthly Weather Rev. 54. pp. 191–194, May, 1926.)—In this paper the author replies to recent criticism concerning the reality of short and long period variations in solar rediation [see Abstract 256 (1926)]. Additional evidence in favour of the reality of these fluctuations is obtained from a further analysis of the Mount Wilson pyrheliometric observations for 1910–1920. The discussion is confined to observations taken at approximately the same time of year, consequently any annual periodicity is eliminated and errors due to changes in solar distance are minimised. Inaccuracies due to variations in the atmospheric conditions are limited by grouping the days according to the atmospheric transparency and the quantity of precipitable water present in the atmosphere. Weighed means of the annual percentage departure from the average for each group, and computed both for the solar constant and pyrheliometric values, show close agreement with the bolometric results. A. W. L.

2785. *Characteristic Movements of Solar Spots, Faculæ and Flocculi.* **R. Sekiguti.** (Imp. Marine Obs. Kobe, Japan, Mem. 2. pp. 83–110, June, 1926.)—In a previous paper [see Abstract 2660 (1925)] the author suggested that the spot vortex is born in the higher region of the solar layers, and gives gyratory movements successively to lower and lower layers, and finally connects its core to the deep-lying "root." He now develops this view. He draws frequency distribution curves for the Greenwich faculæ and for Fox's calcium flocculi, and finds that these do not exhibit the asymmetry which he had found in similar curves for the Greenwich spots. This asymmetry in spots he attributed to the tendency, found by Dyson and Maunder, of a regular spot to move westward rapidly in the early days of its history, and subsequently to decline to its initial position. The asymmetry in spots can be done away by treating separately the early and the later stages. He also investigates the motions in latitude of spots in an early stage of development, and finds that such spots when in low latitude tend to move equatorward. The axis of the zones of maximum spottedness does not appear to influence the distribution of the motions of young spots in latitude. A. S. D. M.

2786. *Solar Motion with Respect to Tenth-Magnitude Stars.* **P. van de Kamp.** (Astron. J. 36. No. 864. pp. 190–191, July 10, 1926.)—A rediscussion of Alden's and van de Kamp's Solar Motion derived from Proper Motions [see Abstracts 506 (1925) and 1266 (1926)] in accordance with Raymond's corrections to the proper motions in declination to Boss's *P.G.C.* [see Abstract 1779 (1926)], from which the author derives A = 281° ± 3°·3, D = + 38° ± 2°·9. This value for the R.A. of the apex is essentially the same as in the earlier paper, but that for the declination of the apex is 7° lower. Solutions for solar motion were also made after dividing the material available into regions above and below galactic latitude ± 30°, and these give essentially the same results for the apex declination, but rather different for the apex R.A.; and this difference seems real. A. S. D. M.

2787. *The Solar Cluster.* **R. A. Sampson.** (Roy. Astron. Soc., M.N. 86. pp. 557–560, June, 1926.)—A further note dealing with a criticism of the earlier paper [see Abstract 2302 (1926)]. It might be suggested that the choice of stars with large proper motions for parallax determinations would tend to simulate the clustering of which the original paper produced evidence. The observations on which the calculations rest are tabulated, and, against this criticism, it is pointed out that while the distribution in each class is similar for all magnitudes, it differs from one class to another. Observational discrimination does not seem able to explain this effect. A. Wh.

2788. *Distribution of Atomic Masses in Stellar Interiors and Capacity.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 86. pp. 561–574, June, 1926.)—Rosseland's conclusion that there will be no tendency for atoms of different atomic masses to separate in different levels is shown to rest on unsound reasoning. Even if the atoms are perfectly mixed at the birth of a star, there will be a slow separation, while if they are already regionally concentrated, separation in layers according to mass will be greatly accelerated. It follows that there is every probability that there will be elements in the interior of stars of greater atomic mass than those known, and this is probably connected with the enormous rate of energy evolution in many cases. Mathematical analysis on the lines of earlier papers shows that a consistent theory can be maintained on these assumptions and that mean stellar atomic numbers may be of the order of 100 to 200. This theory involves modification of earlier work and particularly the assumption that no evolution of energy could result from the degradation of completely ionised atoms since this is no longer capable of correctly placing the "main sequence" bounding the temperature luminosity diagram. A. Wh.

2789. *Exact Equations of Radiative Equilibrium.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 86. pp. 574–578, June, 1926.)—A mathematical solution of Schwarzschild's equation of radiative transfer. Previous solutions have been approximate, and it is desirable to see how far the theorems that have been founded on them are valid. It is shown that in the absence of thermodynamic equilibrium there is no unique definition of temperature, and, in fact, there is no method at present whereby a relation between the T which defines p_G and the T which defines p_R. Errors of the order of ϵ must be introduced, and it is impossible to replace the theorems which become untenable by any new ones. Particularly the theorems of v. Zeipel are affected by this discussion. A. Wh.

2790. *Equilibrium of the Calcium Chromosphere.* **E. A. Milne.** (Roy. Astron. Soc., M.N. 86. pp. 578–599, June, 1926.)—In a recent paper [see Abstract 2306 (1926)] the mechanism whereby an atom in the chromosphere could be accelerated out of its absorption line by radiation pressure was described. In this paper the process is examined more minutely in order to explain why a general movement does not result. It is shown that if the intensity minimum in an absorption line is flat, atoms moving with small inward or outward velocities will be decelerated and will tend to be brought to rest. The velocity distribution set up by this action is calculated and, expressed as a temperature, appears to be slightly more than half the effective temperature of the whole star. The velocity distribution is Maxwellian. The theory is applied to prominences and is believed to explain Pettit's observations more correctly than the theory given by Sur. The shift of the high level lines towards the red demands asymmetry in some condition, and it is suggested that in the acceleration of radially moving atoms this asymmetry is found. A note at the end of the paper points out that the velocity distribution is only ellipsoidally symmetrical. A. Wh.

2791. *Photometry of Astronomical Objects.* **A. F. Lindemann** and **F. A. Lindemann.** (Roy. Astron. Soc., M.N. 86, pp. 600–607, June, 1926.)—In the measurement of stellar radiation, either by statistical or individual methods, the ideal quantity to determine is the spectral energy distribution-curve of each star, but this is possible only for a few of the brightest stars, and the same limitation is found in the bolometric measurement of total intensity. The authors suggest a photoelectric photometer applicable to a larger number of stars, in which, instead of spreading out the light into a spectrum, monochromatic filters are employed. Such filters can be obtained and reproduced, almost transparent to light in desired bands of wave-lengths, and opaque to the rest, and if these were agreed on and standardised, stellar magnitudes determined from them would have some physical significance—the luminosity of stars could be stated in ergs per cm.^{2} within certain wave-lengths by standardising the instrument by a black body at known temperature. The apparatus is described and figured. It consists essentially of the cell-box (of photoelectric cells) and the electrometer, whose zero and sensitivity is independent of position.

The diaphragm which restricts the light to that sent out by one object is of the ordinary iris form ; the filter-box contains three filters transparent in a fairly narrow band, one each in the red, green and violet, and the width of these bands is such that, with a potassium cell and sunlight, the same current approximately is obtained in each, so that it can be seen at once whether a star is hotter or colder than the sun by the ratio of the deflectors. The technical manufacturer of high-tension batteries for wireless telephony has simplified the photoelectric work, and potentiometers, high-tension resistance voltmeters, are good and cheap. A plate shows the complete apparatus with all the necessary batteries, etc., and with it very accurate measures can be made of the emission from stars or other astronomical objects within any desired region of the spectrum.
A. S. D. M.

2792. *Spectrum of Bright-Hydrogen-Line Star H.D.C.* 20336 *in Camelopardalis* (*Sp. Type B3pe*). **W. J. S. Lockyer.** (Roy. Astron. Soc., M.N. 86. pp. 607–618, June, 1926.)—Since 1924 routine programme photographs have been taken of the bright-line-hydrogen stars with the 9-in. prismatic camera of the Norman Lockyer Observatory, which has a dispersion of 46·0 mm. between H_β and H_δ [see Abstract 2225 (1924)]. A brief summary is given of previous work on this star by Espin, [Mrs.] Fleming, Campbell, [Miss] Maury, Curtiss (who deduced an orbital period of about 2·3 years) and Hnatek. The Sidmouth photographs taken between 1923, Sept. 10, and 1925, Dec. 17, divide into four groups, the spectra being practically similar in each group, but showing progressive differences. The appearances and changes in the hydrogen lines are similar to those in ϕ Persei [see Abstracts 2047 (1925) and 2307 (1926)]. A table gives the condition exhibited by the bright hydrogen lines in line of sight, and the estimated relative intensities of the bright red and violet components for the two lines H_β and H_γ, and the latter ratios are also plotted in a figure. The author does not confirm Curtiss's period of 2·3 years, but suggests one of 1·4 years. The helium lines behave differently from those of ϕ Persei ; the bright lines placed centrally on the broad absorption bands do not vary as regards sharpness and diffuseness, nor does λ4471·6 split up into two well-separated absorption lines. The ionised magnesium line at λ4481·3 is sharp in H.D.C. 20336, but almost invisible in ϕ Persei. The bright ionised lines of iron and titanium, prominent in ϕ Persei, are here only just visible. It is probable that, were photographs taken systematically throughout the entire period, cyclical changes in character and intensity would be exhibited. The author concludes that since very similar types of variations take place in the two stars, the causes producing the variations must be fundamentally the same in both, in spite of the great difference in the lengths of their periods.
A. S. D. M.

2793. *Use of a Standard Equinox in Astronomy.* **L. J. Comrie.** (Roy. Astron. Soc., M.N. 86. pp. 618–631, June, 1926.)—Instead of changing our equinox of reference continually, the use of the equinox of 1950·0 is advocated as a standard for cometary and asteroid work. The general specifications of the data which should be tabulated by the Nautical Almanac in order to facilitate the adoption of such a standard equinox are outlined, and later the details are developed, with special reference to the modern tendency towards the use of calculating machines. A new solution of the corrections for differential precession, nutation, and aberration is offered, also special facilities for reducing right ascension, declination, longitude, latitude, or orbital elements to 1950 or *vice versa*. Methods of computing special perturbations are discussed on the basis that the planetary material for the best method should be tabulated. The advantages of Cowell's method for general use, with Encke's as an auxiliary, are emphasised. AUTHOR.

2794. *Observations of V Cassiopeiæ in* 1921–1926. **A. N. Brown.** (Roy. Astron. Soc., M.N. 86. pp. 631–636, June, 1926.)—These observations of a long-period variable star are in continuation of those made by the same observer since 1909. The period has been slowly lengthening: until 1916 it was 227·1 days, from 1916 to 1921 it was 229 days, and for the present series it is 231·7 days. Usually the rise to maximum is more rapid than the fall to minimum; but on four occasions since 1909 the fall was rather more rapid than the rise, and once (in 1913) the rise and fall were of equal duration. M. A. E.

2795. *New Nebulæ shown on Franklin-Adams Chart Plates.* **P. J. Melotte.** (Roy. Astron. Soc., M.N. 86. pp. 636–638, June, 1926.)—Attention is drawn to four nebulæ, apparently not recorded elsewhere, which were noted by the author, and also independently by Lundmark, when examining the Franklin-Adams Chart plates. The nebulæ are described, and a photograph of one is given—a large extended nebula in Vela. M. A. E.

2796. *An Ephemeris of the Geminid Radiant-Point.* **A. King.** (Roy. Astron. Soc., M.N. 86. pp. 638–641, June, 1926.)—The radiant-point of the Geminid meteor-shower was first determined by R. P. Greg in 1862, and its motion was detected in 1885 by W. F. Denning, who published a rough ephemeris in 1923. A list is here given of practically all the published positions, and the average position for each day between Nov. 27 and Dec. 17 has been worked out. They clearly show the eastward drift of the radiant. From these an ephemeris of the radiant-point for the year 1928 has been deduced. M. A. E.

2797. *List of Test Objects for Trigonometric Determinations of Stellar Parallax.* (Astron. J. 36. No. 864. pp. 185–190, July 10, 1926.)

2798. *Study of Bright Spiral Nebulæ.* **H. Shapley** and **Adelaide Ames.** (Harvard Coll. Obs., Circ. No. 294. pp. 1–8, 1926.)—A discussion of 103 bright nebulæ of the spheroidal, oval, spindle and truly spiral forms lying in the Coma-Virgo constellations between R.A.s 12*h*. 3*m*. and 12*h*. 56*m*., and Dec.s + 5° and + 20°. Two-thirds are within five degrees, and thirty-seven are within three degrees of 12*h*. 20*m*., + 13° [see Abstract 2464 (1924)]. A table is given of their dimensions, integrated magnitudes and colour indices, and the cloud of nebulæ include the well-known spirals Messier 58, 61, 88, 98, 99, 100, the spheroidal globular nebulæ Messier 60, 84, 86, 87, and the nucleated pair of spirals N.G.C. 4567–4568. The photographs have been made with several telescopes of different scales, so that both diameters and integrated magnitudes can be obtained; on some the nebular images are small enough to be comparable to nearby stellar images. A figure shows

the frequency of integrated photographic magnitudes, and all but one of the nebulæ are within an interval of three magnitudes, 10·5 to 13·5; most of the dispersion is due to actual differences in luminosity. Hubble has shown from the variable stars within them that Messier 33, 81, 101 and N.G.C. 2403 have distances of the order of a million light years, and that their maximum frequency of photographic magnitudes is about 8·4. That of the Coma-Virgo group is about 12·6, which would place them at the distance of about ten million light-years, with an absolute magnitude of -15, which is of the same order of brightness as the Magellanic Clouds, and not much greater than N.G.C. 6822. The linear diameters are also comparable, being of the order of five to ten thousand light-years. Their colour index is close to that associated with the class G type of spectrum, which is normal for spiral nebulæ. The author's conclusion is that these form a cloud of galaxies of the nature if not quite of the dimensions of our own Milky Way, and that loss of light is not appreciable even when coming from external stellar systems.
A. S. D. M.

2799. *Spectrum and Luminosity of Nova Pictoris*, 1925·4. **P. Davidovich.** (Harvard Coll. Obs., Circ. No. 295. [11 pp.], 1926.)—The pre-maximum spectrum of Nova Pictoris is similar to the ordinary class cF5, and since little is known of the absolute magnitudes of the very luminous giants of classes F0 to F5, the author compares the relative intensities of pairs of selected lines in the nova spectrum with those of the giants ι_1 Scorpii, α Persei (and others), and the dwarf α Canis Minoris (and others). Since the nova spectrum indicated great luminosity, the doublet 4173 and 4178 (and other lines) were selected as showing an absolute magnitude effect in very luminous class F stars. These lines are very intense and equal in ι_1 Scorpii (class cF5; abs. mag. $-2·8$); not so prominent in α Persei (gF5; $-1·5$); and not at all conspicuous, but unequal in intensity, in the dwarf α Can. Min. (dF5; $+3·0$). The discussion of these and other lines shows that those which are strong in giants are also intense in the nova, and those weakened in highly luminous stars are also weak in the nova. The author finds an absolute magnitude of -3 for Nova Pictoris on 1925, May 28, by comparison with ι_1 Scorpii, and at its maximum light on June 9th as about -5 absolute or brighter. The differences between the nova spectrum two weeks before and the day before maximum light are comparable to those between a dwarf and a giant star of the same spectral class. From this it is inferred that the rise of light was due, not to a rise of temperature, but to a decrease of density which amounts to an expansion of the nova; this expansion will bring about decrease of temperature towards maximum light. If the expansion be radial, adopting the nova's absolute magnitude and taking its effective temperature from the estimate of its spectral class, its linear diameter on May 28th was about 50 times that of the sun and was about 90 times on June 9th.
A. S. D. M.

2800. *Celestial Encounter.* **E. W. Brown.** (Frank. Inst., J. 202. pp. 127–163, Aug., 1926.)—The total solar eclipse of Jan. 24, 1925, passed over such a thickly populated area (Connecticut, U.S.A.) that the American Astronomical Society appointed a Committee to consider what observations might be made by an ordinarily intelligent person without special equipment or knowledge, which would advance science if thousands of people took part in them. Therefore the Committee issued widely (through newspapers and other agencies) a set of seven simple questions for answer by the public who observed the eclipse. The astronomical work required of the public was mainly the determination of the northern and southern boundaries of the shadow, and this might be done in three ways: firstly, by direct observation, by those near a boundary, as to whether the eclipse was total or not; secondly, by observers on high buildings or hills looking for the shadow and watching its limiting position as the edge passed to the north or south (this method failed because of haze as seen from above, though the sky seemed clear to those on the ground); thirdly, by observations of the time that totality lasted, the observers being two or three miles from the edge. The positions of the shadow boundaries give the width of the shadow, and the observations obtained indicate that this should be slightly diminished in future predictions. The position of the central line of the shadow track gives the positions of the centres of the sun and moon at the time of eclipse, and this improves the knowledge of the motions of the moon. The predictions furnished by the *Nautical Almanac* Office (U.S.A.) when compared with the observations of second and third contact show that the eclipse was about five seconds late, and this error is due to the faulty positions or diameters of the sun and moon. Final calculations show that the sun was responsible for four seconds and the moon for one second, the errors of the diameters being quite small. Other results are the record by Curtis of the Allegheny Observatory of a new range of bright lines on two plates, taken one before and one after totality, and the observations of the shadow bands, which show that these were formed in some cases close to the ground and depended on swirls in the air caused by wind. **A. S. D. M.**

2801. *Spectrographic Study of Mira Ceti.* **A. H. Joy.** (Mt. Wilson Observat., Contrib. No. 311. Astrophys. J. 63. pp. 281–341, June, 1926.)—Many observers have studied the spectrum of Mira at and near maximum, but its faintness at minimum made spectroscopic observation impossible at that phase until the 100-in. reflector came into use at Mt. Wilson in 1919. A secondary spectrum was detected in 1920, and the faint companion causing it was seen by Aitken in 1923. Spectral changes depend mainly on the magnitude of the star, and therefore vary from cycle to cycle as well as during the course of a single cycle. The fading of the star after maximum is largely due to the strengthening of the characteristic titanium bands in the green and yellow. Near maximum bright lines of ionised iron are seen, and soon after minimum bright hydrogen lines appear and have their greatest intensity near maximum. Low-temperature emission lines of iron, magnesium and silicon appear after maximum is well past. The emission lines give a velocity-curve which indicates outward motion relative to the absorption-line curve, except at minimum, when the difference is zero. The linear diameter of Mira is found by the interferometer to be 490,000,000 km., and the surface brightness at normal maximum (3·5 mag.) is 7·5 magnitudes fainter than that of the sun. The temperature is estimated to vary from 2300° K. to 1800° K. The bolometric variation in energy agrees with the variation in visual magnitude. The companion seems to be a long-period or irregular variable; it is a dwarf of early-type spectrum, with bright lines of hydrogen, helium and ionised iron, but with no absorption lines except those connected with emission bands of the hydrogen series.

In a brief *Discussion* of the possible cause of variation of the Mira type it is pointed out that the emission lines seem to originate in an outward-moving stratum or shell rather than in intermittent explosions like solar prominences, and that titanium absorption plays a much larger part than any general absorption in the star's atmosphere. The companion is a most unusual star, and it will be interesting to observe its variation in brightness, its motion, and the apparent influence of the principal star on its emission lines. M. A. E.

2802. *New Graphical Method for Finding the Elements of a Visual Binary.* **K. Laves.** (Astron. J. 39. No. 865. pp. 1–4, July 31, 1926.)—A new method is explained, founded on a simple geometrical consideration, innate in the problem, by which the elements Ω, a, ω, i of a visual binary are found whenever the apparent ellipse has been drawn. The disadvantages of the graphical methods of Zwiers, Seelinger and Klinkerfues are pointed out; and it is shown that when a change of origin of coordinates is introduced in Kowalsky's analytic method its resulting expressions take a form practically identical with the results of this graphic procedure. M. A. E.

2803. *Radial Velocities of* 368 *Helium Stars.* **E. B. Frost, S. B. Barrett** and **O. Struve.** (Astrophys. J. 64. pp. 1–77, July, 1926.)—Radial velocities of 368 stars of classes B and O were measured on 2431 plates taken with the Bruce spectrograph of the Yerkes Observatory during the years 1901 to 1925. For nine-tenths of these a single prism was used giving a scale of 30 Å. per mm. for the central ray at $\lambda 4500$. Comparison spectra of titanium and iron were used. Forty-three per cent. of these stars have been found to be spectroscopic binaries at Yerkes Observatory or elsewhere. The wave-lengths adopted for the stellar lines of the different elements are listed in Table I. Table II contains the average radial velocities from all lines used; also the velocities derived from the calcium line K and sometimes H, and other data. The results for separate plates are given in Table III. The probable error for the average radial velocity is ± 3·5 km./sec.; for a single spectrogram ± 9·0 km./sec. Systematic errors have been investigated. An effect of coma in one-prism plates, due to the camera lens used until 1923, is believed to have been eliminated by corrections applied. This effect was absent from plates taken with three prisms and from all plates obtained with the new Ross camera lens. The velocities differ by about + 1 km. from those of the Lick Observatory. From 350 stars grouped into 37 separate areas the solar motion was determined as follows: Apex at $\alpha = 283°{\cdot}8$, $\delta = +\,11°{\cdot}7$; $V = 17{\cdot}2$ km./sec. The K-term is + 5·6 km./sec. The average residual velocity of these stars is 10·0 km./sec. AUTHORS.

LIGHT.

2804. *Ultra-Violet Absorption of Two Isomers.* **A. Kirrmann** and **H. Volkringer.** (Comptes Rendus, 182. pp. 1468–1470, June 14, 1926.)—The absorption in the ultra-violet has been measured for two bromoheptenes: (1) $C_5H_{11} - CH = CHBr$; (2) $C_5H_{11} - CBr = CH_2$. The difference between the molecular absorption coefficients is generally small but changes sign around 1980 Å. On each log absorption-frequency curve there are two elementary maxima corresponding with points of inflexion; these are situated around 2125 and 1975 Å. for (1), and 2170 and 1950 Å. for (2). Possible significance of these results in connection with molecular attraction is discussed. A. W. L.

2805. *Three-Colour and Four-Colour Theories.* **E. Schrödinger.** (Akad. Wiss. Wien, Ber. 134. 9–10. pp. 471–490, 1925.)—A theoretical paper on the relation between the Helmholtz and the Aubert-Hering theories. Does not admit of abstracting, but shows that the one system may be converted into the other by a kind of transformation of coordinates in the colour triangle. A. D.

2806. *Report of the Committee on Colour Terminology Questionnaire.* (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 43–57, July, 1926.)

2807. *Transparency of Paint Pigments to Ultra-Violet Radiation.* **G. F. A. Stutz.** (Frank. Inst., J. 202. pp. 89–98, July, 1926.)—Gives particulars of an experimental method for measuring the reflecting and transmitting powers for ultra-violet light of films of paint pigments. The results of an examination of some seventy pigments are clearly set out in tables and graphs. W. H. Ge.

2808. *Reflecting Power of Metallic Surfaces.* **M. Duffieux.** (Rev. d'Optique, 5. pp. 204–212, May, 1926.)—Gives a photographic method for measuring the reflecting power of transparent metal foil for radiation which is not absorbed by quartz. The precision increases with the reflecting power. The error is 1 % for a reflecting power of 0·35 and is less than 0·3 % for reflecting powers above 0·65. The method is unsuitable for reflecting powers below 0·15, but can be used for opaque polished surfaces. W. H. Ge.

2809. *Wave-Length and Total Reflection of Entladungsstrahlen.* **Elizabeth R. Laird.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 39–41, July, 1926.)—Summarises various evidence on this subject, referring chiefly to that part of the radiation from (*a*) a short spark in a Leyden jar circuit in air at atmospheric pressure, and (*b*) the spark of an induction coil after it has passed through 4 cm. or more of air, which is not transmitted by quartz or fluorite. W. H. Ge.

2810. *True Plane Standards of Fused Quartz.* **C. A. Skinner.** (Gen. El. Rev. 29. pp. 528–531, Aug., 1926.)—A brief account of the method of preparing three discs of fused quartz with optically plane surfaces for the U.S.A. Bureau of Standards. The discs are 10 to 11 in. in diam. and 1½ to 2 in. thick, and the maximum deviation from a true plane does not exceed 2×10^{-7} in. A. H.

2811. *Stigmatic and Orthoscopic Corrections.* **C. W. van der Pijl.** (Rev. d'Optique, 5. pp. 241–267, June–July, 1926.)—Further discussion of the subjects treated in a previous paper. [See Abstract 2249 (1925).]
E. F.

2812. *Determination of the Value of an Objective.* **G. Demetrescu.** (Rev. d'Optique, 5. pp. 193–203, May, 1926.)—Deals with some of the criteria which determine the value of an objective. The influence of astigmatism on the validity of the Hartmann criterion is discussed.
W. H. Ge.

2813. *Aberrations of a Symmetrical Optical System.* **G. C. Steward.** (Cambridge Phil. Soc., Trans. 23. pp. 235–263, July, 1926.)—The aberrations produced by a symmetrical optical system may be divided into an infinity of orders, those aberrations being assigned to the same order for which the corresponding displacements from the theoretical focus upon the paraxial image plane depend upon a homogeneous function of given degree in the radius of the exit-pupil and the distance of the object point from the axis of the system. Within the same order they may be divided into groups, each group depending upon given powers of these two quantities; and the number of aberrations in any order rises rapidly with that order. It may be shown, however, that the aberrations of all orders fall severally into one or other of two general types—the "spherical" type and the "coma" type. The aberrations commonly considered are those of the first order, *viz.* the so-called "Five Aberrations of v. Seidel"; they are spherical aberration, coma, astigmatism and curvature of the field, and distortion. The paper investigates the geometrical meaning of the aberrations of higher orders and, in particular, of those of the second and third orders; the method is quite general and may be applied to any order or combination of orders. A description is given of the displacements from the Gaussian image due to these various aberrations separately and also in the presence of one another, for the aberrations of any order modify those of every higher order; and the investigation is carried out not only for the Gaussian image plane, but also for near planes, so that "out-of-focus" effects may be studied. There are considered also the possibilities of the "balancing" of aberrations, for frequently any of a given number of aberrations may affect the image unduly, while collectively they may be permissible. Geometrical methods will not, in general, give an adequate indication of the working of an optical system, for the effects produced are very seriously modified by diffraction phenomena; nevertheless the geometrical investigation is of importance for several reasons. It indicates in some measure how the aberrations may be sorted out for diffraction investigations, and it affords valuable guidance relative to the possibilities of balancing aberrations; moreover, the quantities involved are of use from the point of view of the computing of optical systems. From the point of view of practical optical designing the aberration-coefficients of the various orders may be calculated for a single spherical surface separating media of known refractive indices; and then addition formulæ may be obtained which will give the corresponding coefficients for the combination of any number of surfaces with the same axis.
A. D.

2814. *Application of the Hartmann Test to the Measurement of Oblique Aberrations.* **R. Kingslake.** (Optical Soc., Trans. 27. 4. pp. 221–232;

Disc., 232–241, 1925–1926.)—By performing a Hartmann test on an oblique pencil of light through a lens it is possible to determine the coma and astigmatism with great simplicity and accuracy. The theory of the test has been recently investigated by A. E. Conrady, and an outline of his proof of the formulæ involved is given, together with the complete numerical results of such a test applied to a small inclined telescope objective. The measures of coma and astigmatism obtained for this lens have a probable error of the order of 1%. AUTHOR.

2815. *Note on the Criterion for the Best Position of Focus.* **T. Smith.** (Optical Soc., Trans. 27. 4. pp. 265–266; Disc., 266, 1925–1926.)—The position in which the amount of energy within the first dark ring of the diffraction image of a point is a maximum is suggested as not unlikely to correspond with the best focus found by visual observation in the presence of moderate amounts of aberration. AUTHOR.

2816. *Optical Determination of the Thickness of a Surface Layer on Glass.* **R. Sissingh** and **J. T. Groosmuller.** (Phys. Zeits. 27. pp. 518–522, Aug. 1, 1926.)—A glass prism twenty years old presented a layer 100 atoms thick; on repolishing this was reduced to a few atoms only. The formation of the layer is attributed to moisture. A. D.

2817. *Determination of the Dispersion of Double Refraction and the Thickness of a Crystalline Plate.* **T. Hori.** (Kyoto Coll. Sci., Mem. 9. pp. 313–314, May, 1926. In English.)—A brief note on an interference method of measuring the thickness of a crystalline plate to an accuracy of one-thousandth of a mm. W. H. GE.

2818. *Interference by Diffusion.* **F. Wolfers.** (Comptes Rendus, 182. pp. 1532–1534, June 21, 1926.)—Following up previous work [see Abstract 992 (1926)], in which, for the green ray of mercury and the group 3660 Å., the distance x between the edge of the geometric shadow and the second minimum varied as $\sqrt{\lambda}$; the author now extends this law to all radiations from 3128 to 8000 Å. A. D.

2819. *Dispersion of Electric Birefringence in Camphor.* **R. de Mallemann.** (Comptes Rendus, 182. pp. 1534–1536, June 21, 1926.)—The specific birefringencies of active camphor and of inactive camphor are sensibly the same; and the dispersion is normal. [See Abstract 1106 (1923).] A. D.

2820. *Polarisation of Light in Turbid Media.* **G. I. Pokrowski.** (Zeits. f. Physik, 37. 10–11. pp. 722–727, 1926).—Sequel to [Abstract 1549 (1926)]. Where the particles are a little larger than the wave-length of the incident light, the greater part of the light is scattered by reflection and refraction. A. D.

2821. *Rotatory Power of Organic Compounds as a Function of the pH: Glucosamine.* **E. Vellinger.** (Comptes Rendus, 182. pp. 1625–1627, June 28, 1926.)—The muta-rotation of glucose, which is usually regarded as an ampholyte, is greatly accelerated for extreme values of the pH, but the final rotation reached is sensibly constant. The molecule of glucose exhibits neither acid nor basic functions capable of explaining its amphoteric character. In the case of glucosamine, the final rotatory power varies with the *p*H of the solution, the curve expressing the nature of the variation being similar to that obtained with asparagine. T. H. P.

2822. *Influence of Viscosity on Specific Rotatory Power.* **P. Achalme** and **J. Achalme.** (Comptes Rendus, 182. pp. 1539–1541, June 21, 1926.)—By the substitution in varying proportions of a saturated solution of citric acid for water in N/4 tartaric acid solutions the viscosity of the tartaric acid solution is varied over a wide range, increase of viscosity being regularly accompanied by a diminution of specific rotatory power. In another series of determinations the viscosity is kept constant and the effect of varying tartaric acid concentration on specific rotatory power is compared with its effect when produced by simple dilution with water. The results indicate that concentration has no direct effect on rotatory power, the latter being affected only by the viscosity produced by the concentration. A. B. C. L.

2823. *Rotatory Power of Quartz in the Ultra-Violet.* **J. Duclaux** and **P. Jeantet.** (J. de Physique et le Radium, 7. pp. 200–203, July, 1926.)—The light from a spark between aluminium electrodes was polarised and analysed by reflection from black glass before and after passing through a column of quartz 40 mm. in length; the continuous spectrum was then analysed by refraction through a quartz prism and the positions of the extinctions recorded. The observed rotations per mm. ranged from 91·19° for $\lambda = 3087{\cdot}60$ to 370·9° for $\lambda = 1853{\cdot}98$ Å.U. T. M. L.

2824. *The Rotary Power of Tartaric Acid.* **R. Lucas.** (Comptes Rendus, 183. pp. 29–31, July 5, 1926.)—A whole series of observations relative to aqueous solutions suggests the possibility of two forms of tartaric acid, while, on the other hand, observations of the acid in the presence of various substances (boric, tungstic acids, for instance) do not agree with this simple explanation of the observed anomalies. In a study of camphor it is shown that similar anomalies arise from the presence of two forms in variable proportions, and it is therefore suggested that the behaviour of tartaric acid in presence of these latter bodies might be connected with the appearance of one or more new forms, the *rôle* of B_2O_3, Wo_4H_2, etc., being to modify the proportions. From experimental results and theoretical deductions concerning the general relations which should exist, it is concluded that a new form arises which is strongly dextro-rotary and appears in proportions variable with the foreign substance. It is possible that maleic acid behaves similarly. W. V. M.

2825. *Sensitisation for the Entire Visible Spectrum.* **B. H. Carroll.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 35–37, July, 1926.)—The following bath is recommended for panchromatic plates: 1500 c.c. distilled water; 15 c.c. pyridine; 6 c.c. pinacyanol solution 1 : 1000; 6 c.c. pinaflavol solution 1 : 1000. The pyridine and dye solutions are mixed and then added to the water. Plates should be washed for five minutes in distilled water and then bathed for one hour at a temperature not higher than 15° C. The quantity given above is sufficient for one dozen plates 5 × 7. Spectrographic tests show very considerable increase of speed together with elimination of the minimum of sensitivity usually found in the green. F. S.

2826. *The Relation between the Chemical Constitution of Different Organic Liquids and the Optical Transmissibility of Papers saturated with Them. Part I.* **S. S. Bhatnagar, N. A. Yajnik, M. Prasad** and **B. Ahmed.** (Zeits. phys. Chem. 122. pp. 88–100, July 20, 1926.)—The photometric measurements recorded in this paper were made by means of a Nutting spectrophotometer, full details of the method being included. A necessary condition for illumination is good spreading power of the liquid. Liquids which allow of illumination do so in a definite manner with increasing amounts. It has not been found possible to evaluate exactly the minimum limit of illuminative power owing to experimental difficulties due possibly to the orientation of the molecules in thin layers. The maximum limit, however, has been very rigorously investigated, and the generalised results appear to be: (*a*) That the factor of maximum illumination is a characteristic property of a liquid which is closely bound up with its refractive index and its spreading power on paper, and that the maximum illumination of the system paper-liquid is attained when its refractive index almost attains that of the pure liquid. (*b*) That the factor is an additive property of the liquids employed. The investigation of numerous homologous series gives a more or less constant value for the CH_2 group, and among different influences by which changes can be effected that of chemical constitution is the strongest. (*c*) That isomers give differing illuminations, the normal affording higher values than the iso-compounds. (*d*) That the aromatic hydrocarbons show deviations probably on account of their peculiar constitution and incomplete saturation. (*e*) That a most striking parallelism exists between the illuminating powers and the boiling-points, which are found to increase or decrease together. The maximum illuminating power is thus a unique and characteristic property of liquids, and may afford valuable information with respect to the molecular orientation and chemical constitution of organic compounds. H. H. Ho.

2827. *Action of Light on Concentrated Aqueous Solutions of Ammonium Thiocyanate.* **M. Holmes.** (Chem. Soc., J. pp. 1690–1693, July, 1926.)—Liesegang (1894) noticed that concentrated aqueous solutions of ammonium (or other) thiocyanate, if exposed to sunlight for one minute, turn bright red, the colour disappearing in the dark after two minutes. On investigation of this phenomenon, it is found that fresh concentrated ammonium thiocyanate solutions turn pink after exposure in glass vessels for five to fifteen minutes to the light of the quartz mercury lamp, but never become bright red; traces of gas are evolved. A less intense coloration appears if the solution is contained in a quartz vessel. The colour fades slowly in the dark. Similar results are obtained if sunlight is used. The solutions must be freshly prepared to show these effects, and the presence of air seems to play a part.

It is suggested that the absorption of long-wave ultra-violet light causes the irreversible photo-reaction $NH_4CNS \longrightarrow NH_4CN + S$ (as sol); that the insoluble sulphur forms aggregates of sub-microscopic size which are responsible for the pink colour; that these sub-microns can slowly unite to form particles of microscopic size which are virtually colourless, and that this process of coagulation is accelerated by addition of potassium cyanide or by ultra-violet light of shorter wave-length. The actual extent of the decomposition is very slight and in dilute solutions negligible. T. H. P.

2828. *Spectrum Sensitivity of Photographic Plates for Constant Energy.* **H. Armangau.** (Rev. d'Optique, 5. pp. 213–216, May, 1926.)—As a source of energy an electrical resistance stove is used capable of working to 1400° C., but mostly employed at 1100° C. The distribution of energy in the spectrum of radiations from the interior of the stove being known, spectrum photographs are obtained on the same plate for different degrees of weakening of the source. A curve of blackening for different radiations is thus traced, and for each wave-length one can find the corresponding energy necessary to give a certain fixed density. Details are given of the apparatus employed. The curves obtained connecting wave-length with the logarithm of the photographic intensity all show the same features. The logarithm of intensity rises rapidly at first with decreasing wave-length to about 4700 $\mu\mu$ and then slowly to 4300 $\mu\mu$, while later it decreases. Preliminary tests indicate a slow displacement of the maximum towards longer wave-lengths with increased sensitivity of the photographic plates. [See also Abstract 1766 (1924).] R. S. R.

2829. *Unit of Photographic Intensity. Report of O.S.A. Committee.* (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 567–586, June, 1926.)—One of the chief problems in establishing standardised methods of plate-testing is the adoption of an international unit of photographic intensity. The committee appointed recommended (1) that the unit of photographic intensity be defined as one visual candle-power of radiation having a spectral composition in the region between 350 $m\mu$ and 700 $m\mu$, identical to that emitted by a complete radiator (black body) at a temperature of 5000° K; (2) that in the determination of speed the illumination incident on the photographic material shall be not less than 1·0 nor greater than 10·0 metre-candles; (3) that the exposure be non-intermittent and that the variation in exposure be produced by a variation of the time factor of exposure. The recommendations of the Congress on standard light for sensitometry, exposure to light, development of the negative and subsequent manipulations, measurement of densities, and expression of results are given and discussed. A. E. G.

2830. *Effect of Evacuation of a Photographic Plate on its Sensitivity.* **O. Masaki.** (Kyoto Coll. Sci., Mem. 9. pp. 285–302, May, 1926. In English.)—By reducing or increasing the pressure on the surface of a photographic emulsion it may be possible to vary the sensitiveness and the contrast of density. The author has examined the variations of inertia and contrast by evacuation. In many plates the inertia is decreased, *i.e.* the sensitivity is increased and also the contrast is increased by the evacuation of the photographic emulsion before the exposure. Similar and more remarkable results are obtained when the plate is exposed in a partial vacuum. These effects are generally greater in plates of low than in those of high speed. In the case of prolonged exposure to light that has a very small photographic action on the plate in the partial vacuum, the sensitivity decreased inversely while the contrast increased more markedly than in the previous case, and the two characteristic curves, treated and untreated, intersect at a point. Therefore the evacuated plate has greater density than the untreated when the exposure to the red light is shorter. Hence there is less fog on the evacuated plate than on the untreated plate during development. The greater part of these effects may be attributed to the drying of the emulsion, but the removal of other occluded gases probably plays some part in them as well. [See also Abstract 94 (1925).] A. E. G.

2831. *Application of Kathodic Pulverisation for the Preparation of Photometric Wedges in Platinum.* **F. Artigas.** (Rev. d. Optique, 5. pp. 217–226, May, 1926.)—In this paper an account is given of a series of researches made with a view to replacing gelatine photometric wedges by wedges more "neutral" and more lasting, prepared by the kathodic pulverisation of platinum. This metal not being rigidly neutral for all radiations of the visible spectrum, an attempt is made to obtain absolutely neutral layers by the superposition of platinum and of silver in a certain proportion. [See also Abstract 2135 (1924).] A. E. G.

2832. *Photography — Diffuse and Specular Density.* **C. Tuttle.** (Eastman Kodak Co. Research Lab. Comm. No. 258. Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 559–565, June, 1926.)—A chart of the logs of diffuse and of specular density gives a straight line. The relation of the scatter ratio to the density is not linear even for low values of density. A. D.

2833. *Experimental Study of Phosphorescence.* **F. Dacos.** (Assoc. Ing. Él. Liége, Bull. 3. Sér. 7. pp. 291–320, Nov., 1925, and 4. Sér. 7. pp. 86–97, May–June, 1926.)—A long thesis in which the formation of mixed crystals by the impurity causing the phosphorescence is discussed, together with the bearing of the photoelectric effect on phosphorescence. W. H. Ge.

2834. *Relation between Intensity of Fluorescence and Concentration in Solid Solutions.* **E. Merritt.** (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 613–622, June, 1926.)—The explanation of the optimum concentration given by Bruninghaus [Abstract 376 (1916)] has received no experimental confirmation, and his equation $I = K . x . e^{-kx}$ fails to represent recent measurements. Perrin [Abstract 1214 (1919)] has suggested two alternative reasons for the decrease of the luminescence at the higher concentrations. Adopting Perrin's second hypothesis, the expression $I = K\frac{x}{c + x}e^{-kx}$ is obtained, where x is the molecular concentration of the impurity in the solvent. This agrees in character with most observations. A quantitative test of the equation has recently been carried out by Nichols and Slattery [Abstract 2087 (1926)] for the case of three uranium phosphors, and an agreement as good as can be expected is claimed. J. E.

2835. *Qualitative Study of the Fluorescence of Bromine Vapour.* **P. Daure.** (Comptes Rendus, 183. pp. 31–33, July 5, 1926.)—Certain absorbing vapours give rise to a fluorescent radiation (or optical resonance), certain rays being re-emitted almost isolated or perhaps with satellites. The intensity of the fluorescence decreases as the pressure increases by addition of transparent gas. The author has studied the resonance radiation of bromine vapour using solar light as incident radiation. By interposition of different filters the exciting radiation has been localised as between 5000 and 5600 Å., certain frequencies here coinciding with bromine absorptions. The well-known modification of the absorption rays by compression is verified. The re-emitted light, which appears in a small spectrograph to have a continuous spectrum, the dispersion being too small to separate the crowded lines, contains more long-wave radiation than the incident light. The author is of the opinion that the fluorescence of bromine vapour consists in the re-emission of absorption lines accompanied by satellites situated towards longer wave-lengths. The light absorbed by the continuous band does not give rise to re-emission. W. V. M.

2836. *Path of Light Quanta in an Interference Field.* **G. N. Lewis.** (Nat. Acad. Sci., Proc. 12. pp. 439–440, July, 1926.)—Defends against the criticism of Tolman and Smith a proposed crucial experiment intended to decide sharply between the author's new theory and all previous theories of light. W. H. Ge.

2837. *Luminosity Duration of the Atom with Reference to the Alkalies and in the Magnetic Field.* **E. Rupp.** (Ann. d. Physik, 80. 5. pp. 524–532, July 13, 1926.)—The data obtained by Wien's method [see Abstract 379 (1920)] for the luminosity duration of atoms has hitherto not been explained either on the Maxwell theory or from quantum considerations. In view of the paucity of data, the present investigation relates to further measurements of the luminosity duration of metals of the alkali series by a somewhat modified Wien procedure. Bright alkali canal rays were produced by bombarding a salt anode with electrons from a glowing wire. The spectral lines of the subsidiary series of lithium and the chief series lines of potassium have been photometrically examined and the fading constants evaluated. An external magnetic field of 12,000 gauss perpendicular to the canal rays was found to have no appreciable influence on the results. A certain amount of theoretical treatment is included. H. H. Ho.

2838. *Effect of an Electric Field on the Radiating Hydrogen Atom.* **K. L. Hertel.** (Nat. Acad. Sci., Proc. 12. pp. 440–442, July, 1926.)—It has been found experimentally that the light from a radiating hydrogen atom in the canal rays at reduced pressures is partially polarised with the electric vector of the stronger component parallel to the bundle. This polarisation decreases faster than the intensity as the radiating process goes on. When the rays enter or leave an electric field the polarisation is altered in the same direction in each case, such that the component at right angles to the bundle is increased relative to the component parallel to the bundle. In a uniform field there is a tendency for the polarisation to gradually disappear as in the absence of a field. The effects due to the field can be noticed at 15 volts per cm. and increase up to the strongest tried (8000 volts per cm.). No certain effects due to a magnetic field at right angles to the rays could be observed. W. H. Ge.

2839. *Some Relations between the Optical Spectra of Different Atoms of the Same Electronic Structure. Part II. Aluminium-like and Copper-like Atoms.* **D. R. Hartree.** (Cambridge Phil. Soc., Proc. 23. pp. 304–326, July, 1926.)—The relevant results from a previous paper [see Abstract 847 (1925)] are summarised. The main new results are for penetrating orbits. Assuming a central field of force, it is shown that the quantum defect q for such an orbit can be expressed as the sum of contributions from the electrons in groups of core orbits of different principal quantum number *n*, and further that if for a given atom in different states of ionisation corresponding orbits of the series electron are compared, the contribution to q from a set of core orbits of given n is very nearly independent of the degree of ionisation so long as the number of electrons in core orbits in the group remains the same. It follows that, if q is the quantum defect for a term of the spectrum of an atom core charge C, the core of which contains s_M orbits of principal quantum number M and none of higher quantum number, and q' is the quantum defect for the corresponding term in the spectrum of the atom of the same element with core charge $C + s_M$, which differs from the atom of core charge C only in lacking the core orbits of principal quantum number M, then $q - q'$ is approximately the contribution from the core orbits of principal quantum number M to the quantum defect for the term of the atom core charge C. It is shown that if corresponding terms of different atoms of the same electronic structure are compared, for large values of C the contribution to q from any group of core orbits should tend asymptotically to be proportional to the average true mean radius of these orbits, and its reciprocal should tend asymptotically to be linear in C. Similar relations are obtained for $Q = dq/d(\nu/R)$. These results are compared with the values of q deduced from the terms of such observed spectra of aluminium-like and copper-like atoms as are available, and it is found that though the theoretical relations are only established as asymptotically true for large C, there is a considerable measure of agreement with spectra for small values of C, which are the only ones which can be observed. W. V. M.

2840. *Spectral Structure. Progress Committee for* 1924–1925. (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 587–611, June, 1926.)—This is a report of the committee on physical optics, and gives a clear summary of the work done on spectral structures and their theory, spectral intensities, spectral series and atomic structures, band-spectra, resonance radiation, photoelectric effect and the velocity of light. A bibliography of 125 references is appended. F. S.

2841. *Interpretation of Spectra.* **O. Laporte.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 1–24, July, 1926.)—The first part of the paper deals with recent theory, and after a comparison of the three prevailing systems of quantum numbers, considers the behaviour of an atom in a magnetic field. The occurrence of polyfold terms and their Zeeman patterns are thus accounted for. The spectra of multiply ionised atoms are then considered. In the second part of the paper the methods developed in the first part are applied to small periods in the first instance and then, in greater detail, to the spectra of the second long period. F. S.

2842. *Vacuum Spectroscopy.* **I. S. Bowen.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 89–93, July, 1926.)—One of a series of reports prepared at the request of the National Research Council and presenting in brief outline a summary, more or less critical, of the methods which may be employed in various kinds of physical measurements, the present report dealing with vacuum spectroscopy. W. H. Ge.

2843. *Study of the Structure of Bromine Lines.* **T. Hori.** (Kyoto Coll. Sci., Mem. 9. pp. 307–312, May, 1926. In English.)—A long robust discharge-tube giving a satisfactory spectrum is described. For an analysis of the lines an echelon grating consisting of twenty plates of 1·5 cm. thickness was used in combination with a constant deviation or direct-vision prism. The structure of some fifty lines is described, those similar in structure being tabulated together. A number of constant frequency differences are noted. W. V. M.

2844. *Reversal of the Hydrogen Series in the Extreme Ultra-Violet.* **T. Lyman.** (Nature, 118. pp. 156–157, July 31, 1926.)—A repetition of previous experiments [see Abstract 2975 (1924)] with the purpose of improving the technique and confirming the results. The best results were obtained by admitting hydrogen into the discharge-tube at a pressure of about 1 mm. On applying the explosive condenser discharge the first four members of the series—1215·6, 1025·8, 972·5, 949·7—appear on the photographic plate sharply reversed. It seems that a very small quantity of hydrogen is sufficient to produce reversal. The first two members of the series were obtained with helium containing a trace of hydrogen. E. F.

2845. *Secondary Spectrum of Hydrogen and the Occurrence of H_3^+.* **H. D. Smyth** and **C. J. Brasefield.** (Nat. Acad. Sci., Proc. 12. pp. 443–447, July, 1926.)—As positive ray analysis has shown that under proper conditions H_3^+ ions are far more numerous than H_2^+ ions, a search was made to see if any part of the secondary spectrum was due to H_3 or H_3^+. Purified dry hydrogen was passed continuously into a discharge-tube with a tungsten filament kathode. To the side of the discharge-tube was attached a device for measuring the relative concentrations of different ions. A photograph of the discharge was taken simultaneously. The results so far obtained show that the conditions which favour the production of H_3^+ also favour the excitation of Fulcher bands, particularly those in the red. F. S.

2846. *A Simple Vacuum Tube demonstrating the Doppler-Effect on the Balmer Lines of Hydrogen.* **G. Nakamura.** (Kyoto Coll. Sci., Mem. 9. pp. 303–305, May, 1926. In English.)—A short description of a vacuum tube containing a hollow cylindrical kathode 3 cm. long and 5 mm. diameter suitable for observations of Doppler-effects in hydrogen. Various photographs of spectra are included showing the doubled lines of the Balmer series. W. V. M.

2847. *Dissociation of Potassium Iodide and Absorption Spectra of Iodine and Potassium Iodide.* **W. R. Brode.** (Am. Chem. Soc., J. 48. pp. 1877–1882, July, 1926.)—The absorption spectra of KI solutions are determined under various conditions, and it is found, particularly with highly concentrated solutions, that the satellite band has the same frequency of vibration as the first absorption band of I in KI. This satellite band is increased, while preserving its type, by exposure to light under oxidising conditions, and can be removed by the addition of $Na_2S_2O_3$. It is concluded that it is due to free I and not to KI. The absorption spectra of I are determined in alcohol, aqueous KI, and CCl_4; in CCl_4 the absorption spectrum is remarkable for its high transmission in the ultra-violet, giving rise to the suggestion that such a solution might find considerable use as a light filter to exclude visible light and transmit most of the ultra-violet light to a frequency of 1150 f. (the cut-off point of the solvent). A. B. C. L.

2848. *Simple Spectral Apparatus with Strong Illumination.* **K. Schaum.** *Spectrography of Feeble Sources.* **W. Kraemer.** (Zeits. Wiss. Phot. 24. pp. 219–223, Aug. 1, 1926.)

2849. *Ultra-Violet Absorption Spectra and Photochemical Decomposition of Gaseous Hydrogen Bromide and Iodide.* **H. C. Tingey** and **R. H. Gerke.** (Am. Chem. Soc., J. 48. pp. 1838–1850, July, 1926.)—Photographs are given of ultra-violet absorption spectra of carefully purified gaseous hydrogen bromide and iodide at various temperatures and pressures, the source of radiation used being the continuous spectrum from a hydrogen discharge-tube. It was not found possible to excite an emission spectrum of hydrogen bromide in the ultra-violet by means of either an electric discharge through the gas or active nitrogen. The photographs of the spectra show no band structure, but exhibit continuous absorption extending from the limit of the quartz region in the ultra-violet to a long-wave limit, which is 2640 Å. for hydrogen bromide and 3320 Å. for hydrogen iodide. The data support the hypothesis that this is a case of molecular absorption in which the function of the radiation is not to produce a band-spectrum, but to produce direct photochemical dissociation of the molecule into atoms. T. H. P.

2850. *Absorption Spectra of Ethylene Derivatives.* **J. Errera.** (J. de Physique et le Radium, 7. pp. 215–216, July, 1926.)—The results are given of measurements of the ultra-violet absorption of dihalogen derivatives of ethylene, namely dichloro-, dibromo-, diiodo-, chlorobromo- and chloroiodo-ethylenes. Those containing iodine show an inversion of absorbing power above 3000 Å. Reference is made to the similar behaviour of benzene derivatives. **Errata** (*ibid.*, p. 229, Aug., 1926.) F. S.

2851. *Absorption Bands of Compounds of Rare Earths, their Modification by a Magnetic Field, and Magnetic Rotation of Plane of Polarisation at Very Low Temperatures.* **J. Becquerel, H. K. Onnes** and **W. J. de Haas.** (K. Akad. Amsterdam, Proc. 29. 2. pp. 264–275, 1926. In English. Comm. No. 177 from the Phys. Lab., Leiden.)—Experiments on zenotime, tysonite, parisite and bastnæsite. The absorption band-spectra, rich in lines at the temperature of liquid air, simplify at 14° K. and on the whole still more so at 4°·2 K. (liquid He); but new lines also appear. In a magnetic field the components resulting from the resolution of the bands correspond to the absorption of circular vibrations; the variations of the period were independent of the temperature down to 4°·2 K. The dissymmetry in the intensities of the components corresponding to oppositely circular waves was accentuated at 4°·2 K. The rule, valid down to 14° K., that the tendency to dissymmetry is shown by an increase in intensity of the components displaced towards the shorter wave-lengths, is departed from at 4°·2 K. in some exceptional cases. The magnetic rotatory power continues down to 4°·2 K. to be inversely proportional to the K. temperature and directly to the magnetic field, subject to a correction under which the increase with 1/T is smaller at lower temperatures; and apparently the ratio of the rotations at two temperatures is not completely independent of the wave-length. There appear to exist two kinds of magnetic rotation of the plane of polarisation. One of these, generally in a positive direction, is the result of the Zeeman-effect on the absorbed rays, and its existence is apparent from the dispersion. The other should occur in paramagnetic bodies, be negative, and result from a disymmetry of the intensity in the absorption of opposed circular waves caused by orientation or distortion phenomena brought about by the field. These two opposed effects should be superimposed in paramagnetic bodies, one or the other predominating. The magnetic rotary power of paramagnetic substances is generally negative, but is sometimes positive. A. D.

2852. *Band Series in Infra-Red Absorption Spectra of Organic Compounds. Part II.* **J. W. Ellis.** (Phys. Rev. 28. pp. 25–35, July, 1926.)—The absorption bands of secondary intensity occurring, in addition to the more pronounced members of the previously described C-H series, in the short wave-length infra-red spectra of methyl iodide, methylene chloride, methylene bromide, methylene iodide, chloroform and bromoform are accounted for on the basis of linear C-Cl, C-Br and C-I series starting at $16\cdot8\,\mu$, $17\cdot2\,\mu$ and $17\cdot5\,\mu$ respectively; and on the basis of simple additive combinations between these frequencies and those of the C-H series. [For Part I see Abstract 1582 (1926).]

AUTHOR.

2853. *Infra-Red Absorption Spectra of Cyclic Derivatives.* **J. Lecomte.** (Comptes Rendus, 183. pp. 27–29, July 5, 1926.)—The author has compared the absorption spectra of benzene derivatives and cyclohexene and cyclohexane derivatives between $2\cdot85\,\mu$ and $8\,\mu$, that is to say, compounds containing triple, single and no double bands respectively. The effect of the bands is difficult to explain, but they cause no real bands in this region but a reinforcement of absorption in certain regions, uniting, for instance, several small bands in the region of $6\,\mu$ into one large one in the passage from cyclohexane to cyclohexene. The two chief zones of opacity are $3\cdot5\,\mu$ and about $7\,\mu$ separated by a zone of feeble absorption. The introduction of a methyl group causes a strong band to appear at $7\cdot40\,\mu$ or renders the band more intense if it already existed. The groups CO, OH, and Co in cyclohexanone, cyclohexanol, and acetate of cyclohexyle make the spectra simpler by suppressing feeble bands between $3\cdot5\,\mu$ and $6\cdot5\,\mu$. A table of maxima of absorption completes the paper. [See Abstract 1647 (1925).] W. V. M.

2854. *Band-Spectra of the Halogens.* **G. Nakamura.** (Kyoto Coll. Sci., Mem. 9. pp. 315–367, May, 1926. In English.)—For photographing the spectra a Michelson 15-cm. plane grating was used in conjunction with a collimator lens of $3\cdot7$ m. focus and telescope objective of $5\cdot5$ m. focus. In the fourth order the dispersion was about $0\cdot75$ Å. per mm. Preliminary measurements were made with a spectrograph with a Hilger replica grating giving $0\cdot043$ mm. per Å. in the first order. In the first part of the paper the effects of higher temperature and foreign gases upon the absorption of iodine vapour are investigated. The absorption in the red develops to a remarkable degree as the temperature is raised, the bands being attributed to a highly activated diatomic molecule. Under high dispersion the lines persist to almost complete dissociation. The effects of admixture of H_2, O_2, N_2, CO_2, air, CS_2 vapour, alcohol vapour, etc., were tried. The action of all is similar, but the inactive gases are less operative than the chemically active. Lines become diffused as the pressure of gas is raised, and generally speaking the lines strengthened by temperature are suppressed by a foreign gas. The second part of the paper is devoted to an analysis of the spectra of I, Br and Cl. Although Mecke's formula is found not to be applicable to the red bands of iodine at low temperature, it can be extended to the thirty new edges found at high temperature. Tables are given for all three vapours showing the agreement of the observed results with the formulæ of the Deslandres type. F. S.

2855. *Fine Structure of Cadmium Lines.* **H. Nagaoka** and **T. Mishima.** (Imp. Acad. Tôkyô, Proc. 2. pp. 201–203, May, 1926. In English.)—The structure of a number of lines was examined, using four quartz Lummer-Gehrcke plates. The characteristic feature is the strong reversal indicated, especially when the vapour is dense. The position of the satellites depends on the condition of the source of light, and there is some doubt whether the interference points observed refer to real satellites, or are produced by some condition of the vapour round the anode which is bombarded by the kathode rays. H. N. A.

2856. *Effect of Electric Field on the Spectral Lines of Zinc and Cadmium.* **Y. Fujioka.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 68. pp. 45–53, July, 1926. In English.)—An experimental investigation by the Lo Surdo method of the Stark-effect for zinc and cadmium is described. In the electric field the lines of the diffuse series were found to be displaced towards the higher wave-lengths, and it was noticed that their intensity was enhanced. As in the case of mercury, considerable numbers of "forbidden lines" violating the rule for change of azimuthal quantum number appear under the influence of the field. These were examined and their intensities compared with those of neighbouring lines of the diffuse series. The data obtained enabled several new energy levels to be determined. W. S. S.

2857. *Distribution of Intensity in the Fine Structure (Satellites) of the Cadmium Triplet.* **J. L. Snoek** and **T. Bouma.** (Zeits. f. Physik, 38. 4–5. pp. 368–369, 1926.)—The measurements of the intensity of the fine structure of the mercury lines 5461, 4359 and 4048 Å., which had been made by Snoek [see Abstract 1579 (1926)], are now extended to the analogous cadmium triplet. In order to minimise absorption, an intermittent cadmium arc in vacuum was employed. On account of the long exposure necessary with the arc, the difficulty in the observations is such that the measurements are not so exact as in the case of the mercury triplet. No satellites have yet been found in the case of zinc, but with greater resolving power and a more suitable source of light these should be found, and experiments are in progress with this object in view. T. B.

2858. *Explosion Spectra of Hg, Cu and Fe.* **T. Hori.** (Kyoto Coll. Sci., Mem. 9. pp. 379–403, July, 1926. In English.)—The wires were exploded in a confined space by rectified current from a 1-kw. transformer used to charge a 0·3-mf. condenser. In the case of Hg the filament was obtained in a very fine capillary, mounted in a fibre block. Spectra were taken simultaneously with a constant-deviation spectrograph and a small quartz spectrograph. Tables are given of the lines found in absorption with their series notation. It was found that a continuous background is developed by exploding Hg in a confined space both at atmospheric and reduced pressures. A number of absorption lines due to excited atoms was obtained. The order in which lines appeared reversed was studied by varying the voltage. The subordinate series lines of Na, unclassified pairs and triplets of Ca, arc lines of Si, and the Swan spectrum were observed reversed as impurities. F. S.

2859. *Spectroscopic Study of the Discharge in Helium.* **T. Takamine.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 69. pp. 55–61, July, 1926.)—Two methods of excitation were used. The first was Anderson's method of exploding wires, the gas being contained in a pyrex glass tube with quartz window. From 10 to 300 flashes were used for one exposure, and the spectrum was photographed with a metre concave grating. The lines $\lambda 4922$ (2P–4D), $\lambda 4472$ (2*p*–4*d*) and $\lambda 3203$ (ionised helium line) were found to show a depression of intensity in the middle. This is attributed to the interatomic field produced by the closely packed atoms at high current densities. The second method of excitation was condensed discharge at fairly high pressures. For this a pyrex glass tube, with internal capillary which could be viewed end-on, was used. In this case the lines $\lambda 6678$ (2P–3D), $\lambda 5876$ (2*p*–3*d*) and $\lambda 3889$ (2*s*–3*p*) showed a depression of intensity. The same explanation is put forward in this case also in preference to that of self-reversal. F. S.

2860. *Stark-Effect of Lithium Anode Rays.* **A. Poirot.** (J. de Physique et le Radium, 7. pp. 217–224, July, 1926.)—The halogen salt of lithium was mounted on a platinum point and surrounded by a heating coil. The rays, after passing an iron wire grid, proceeded to a polished copper plate. The potential between these could be varied from 0 to 15,000 volts. Detailed results are given for the 4602 line. It was noticed that in intense fields the red colour of the tube changed to blue. The electric field in the tube has also been studied, the conclusions confirming hypotheses made concerning the conditions of emission of anode rays. F. S.

2861. *The Spark Spectrum of Potassium.* **T. L. de Bruin.** (Zeits. f. Physik, 38. 1–2. pp. 94–103, 1926.)—According to the Sommerfeld-Kossel displacement rules the spark spectrum of potassium should be similar to the arc spectrum of the rare gases and particularly to that of argon. The neon spectrum, according to Paschen, gives 12 term series in the first subsidiary, 4 in the second subsidiary and 10 in the principal series. Landé has investigated the inner quantum numbers. The argon spectrum has not yet been analysed. Electrodeless discharge in potassium vapour was used by the present author, the paper containing a large number of observed and tabulated wave-lengths. The dispersion was 8·7 Å. per mm. in the first order. It was found that a large number of lines in the K II spectrum may be arranged in groups of 10 lines with constant differences, and a scheme of levels is drawn up similar to the scheme for neon. A tenfold P term is found. The P terms have the same inner quantum numbers as the P term of neon, and the P differences follow the same law. W. V. M.

2862. *Spark Spectrum of Lithium.* **S. Werner.** (Nature, 118. pp. 154–155, July 31, 1926.)—New spark lines have been found, making it possible to establish a series scheme of the terms of the lithium spark spectrum analogous to those of the parhelium spectrum. It is proposed to call the system, which by analogy with the parhelium spectrum must include the normal state of the spectrum, the Li II *p*-spectrum, the other being denoted by analogy with the orthohelium spectrum as the Li II *o*-spectrum. As first observed by Schüler [see Abstract 1107 (1925)] and recently confirmed by the author, the Li II *o*-spectrum is not a doublet but seems to be a special type of triplet spectrum. The tabulated results confirm and supplement those given in a recent paper by Schüler. [See Abstract 2602 (1926).] E. F.

2863. *Electric Stimulation of Metal Vapours in a King Resistance Furnace.* **H. Schüler.** (Zeits. f. Physik, 37. 10–11. pp. 728–731, 1926.)—Method described. The spectra obtained have the character of arc spectra; they are of great intensity, and they show a great dispersion of extraordinary sharpness. Method also described for finding energy relations. A. D.

2864. *Action of an Electric Field on the Optically Excited Spectrum of Mercury.* **A. Terenin.** (Zeits. f. Physik, 37. 9. pp. 676–680, 1926.)—In an electric field of 50,000 volts/cm. only the lines $2p_i - 3(d_j, D)$ and $2P - 3(d_j, D)$ of the optically excited spectrum were markedly affected. A disappearance of the lines takes place owing to the fact that these lines are displaced with respect to the exciting emission lines of the source. Since all the other lines connected with the state $2p_i$ (for instance, the lines $2p_i - 2s$) are unaltered, only the state $3\,d_j(3\,D)$ is affected. Detail of the experimental portion of the work is given. W. V. M.

2865. *Spectral Structures for Elements Rubidium to Palladium.* **W. F. Meggers** and **C. C. Kiess.** (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 417–447, May, 1926.)—A continuation of a former investigation [see Abstract 849 (1925)]. The laws of spectral structure there exemplified have been modified and extended, and the present paper deals with the regularities in the elements of the second long period. Additions to the rules are the extended selection rule for *k*, the quantitative rules for intensities, and the introduction of the *l* quantum number to replace *k* when dealing with a group of valence electrons. As a result of discussion of the regularities in the spectra of these elements, the interval rule is shown to be only approximate, and to be in error more and more as the elements become heavier. In certain levels the separations are qualitatively the reverse of those expected. Again the Landé *g*-values for the splitting of a level in low magnetic fields deviate from the expected values to a greater extent as the atomic number increases, and they increase progressively as the levels rise. It now appears to be a general rule (correcting the earlier paper on this point) that true raies ultimes involve the term with lowest energy in the spectrum, although in rare instances, where there are two or more low terms of nearly the same value but with different *j*'s, the empirical raie ultime may involve the higher level if this has the larger quantum numbers. Examples are given of typical multiplets for each element in the period. A. C. M.

2866. *Doublets of Stripped Atoms of the Potassium Type.* **R. C. Gibbs** and **H. E. White.** (Nat. Acad. Sci., Proc. 12. pp. 448–451, July, 1926.)—From known values for the first doublet of the principal series of K I and Ca II, and assuming a linear relation between $\nu = 4s - 4p_2$ and the atomic number Z, the corresponding value for Sc III was located about 2700 Å. The separation was calculated from Sommerfeld's regular doublet law and the pair identified in Eder and Valenta's table. The doublet belonging to Ti IV was similarly predicted and found in the vacuum spark spectrum; while that of V V was identified in photographs obtained with a vacuum spectrograph. The regular doublet law is thus shown to hold for this range of elements, and it is hoped to extend the series to Cr VI and Mn VII. F. S.

2867. *Theory of Circulating Electrons.* **G. Wentzel.** (Zeits. f. Physik, 37. 12. pp. 911–915, 1926.)—The calculations of Goudsmit and Uhlenbeck and others show that the doublet separations of H and He^+, as well as of X-ray spectra to a first approximation, are explained if a suitable impulse and magnetic moment be ascribed to the electron. The difficulty that this theory leads to values of the screening constant of X-ray spectra which are considerably too large is discussed. F. S.

2868. *The Refractive Index of Röntgen Rays.* **W. Ehrenberg** and **H. Mark.** (Zeits. f. Physik, 38. 1–2. pp. 129–136, 1926.)—There are anomalies in the vicinity of an absorption. The Darwin-Ewald theory [see Abstracts 1079 and 1262 (1914), 670 (1916), 950 (1918)] does not explain these. A new equation will be put forward. A. D.

2869. *X-Ray Spectra and Chemical Combination.* **E. Bäcklin.** (Zeits. f. Physik, 38. 3. pp. 215–226, 1926.)—A continuation of a previous paper on the influence of chemical union on the X-ray spectra of the lighter elements; the results previously obtained and those of B. Ray are discussed. When an oxide is formed, the molecules at air-temperature contain an amount of energy which is less than the sum of the energies of the atoms in their original state, since the heat of combination has been given out, and the greater part of this energy must have come from the energy of the electron systems, and this must imply an alteration in the energy content of the different levels. If this alteration is such that the differences between the levels are changed the X-ray spectrum will be altered. The shifts of certain lines measured on the photographic plate were as follows: $SK\alpha_2$ to $SO_4K\alpha_2$ 0·361 mm., $SK\alpha_1$ to $SO_4K\alpha_1$ 0·362 mm., $SK\alpha_4$ to $SO_4K\alpha_4$ 0·362 mm., so that there is little difference between the amount of shift caused by oxidation for these lines. The distance from $K\alpha_2$ and $K\alpha_4$ for pure silica was 7·640 mm., and for SiO_2 7·823 mm., showing a marked increase. Interesting results were obtained with the other K lines of silicon, and some tentative theoretical conclusions are drawn. H. N. A.

2870. *Spectrography of Very Long X-Rays.* **A. Dauvillier.** (Comptes Rendus, 183. pp. 193–195, July 19, 1926.)—By the method already described [see Abstract 2111 (1926)] the K_α line of carbon has been traced to the third order corresponding to 138 Å., and the $K\alpha_2$ line of boron located at 73·5 Å. In one instance, when the boron burnt in the tube, the $K\alpha_{1,2}$ of oxygen was found at 24·8 Å. No lighter element has a characteristic X-ray spectrum. A number of L spectra have been investigated by use of a Wehnelt kathode charged on the back to prevent deposition. The L_α line of Fe has been followed to the fourth order (70 Å.) and of Cu to the ninth order (120 Å.). No elements lighter than Cr have an L spectrum. M-series have been found for Ta and W, but not for Zn, Mo or Ba. All the spectra (K, L, M or N) so far investigated in this new region of wave-length consist of a single line. F. S.

2871. *A Probable Action of Matter on Radiation Quanta.* **F. Wolfers.** (Comptes Rendus, 183. pp. 276–277, July 26, 1926.)—An investigation of new phenomena presented by light and by X-rays has led to the following hypothesis, which has points of similarity with Perrin's molecular induction, *viz.*: designating as *photons* the projectiles which are assumed to transport the radiant energy by their possession of a frequence periodicity, the author supposes that the photons may be repelled by material atoms when they pass in their immediate vicinity, at least for the case of orientated atoms, which form the surface of separation of two media. This repulsion may be imagined as due to a kind of resonance between the photons and some resonators, which are just sufficiently removed from the trajectory to avoid absorption effects. In the case of X-rays the author's experiments have shown that the shadow of an opaque object projected upon a sensitive plate is systematically too large, and the real edge of the geometrical shadow is separated from the apparent by a visible fringe. Analogous facts are recorded for light from 8000 to 3100 Å.U., and the author's theory of supplementary fringes permits the relative intensities of these to be determined approximately by means of graphic constructions. Two very different co-existing effects are distinguished: (1) The supplementary fringes for light and the unique black fringe for X-rays appear to be due to diffused waves at the surface of the screen, and this diffusion demands the intervention of certain elements of discontinuity; (2) a deficiency of energy occurs along the edge of the geometrical shadow. Several hypotheses are discussed with regard to (2), but rejected in favour of the explanation given at the outset. H. H. Ho.

2872. *Long-Chain Organic Compounds—X-Ray Spectrographic Study of their Structure and Orientation.* **J. J. Trillat.** (Ann. de Physique, 6. pp. 5–101, July–Aug., 1926.)—The work of Muller, Shearer, Piper, Gibbs and others has shown that numerous long-chain organic compounds (fatty acids, alcohols, ketones, etc.) deposited on glass are orientated in such a manner as to exhibit, on X-ray examination, exactly equidistant rectangular planes. Spectrographs, by the rotating crystal method, prove that these planes increase regularly in distance apart with the number of CH_2 groups in the chain, and, in fact, serve to identify the organic compound. The author has repeated this work and has extended it on both the physical and chemical sides. Thus on the physical side he has examined the influence of the method of depositing the fat on the glass plate, the use of amorphous and crystalline supports for the fats, etc. On the chemical side a study has been made of the structure of the fatty acids (saturated) up to those of very high molecular weight (C_{25}, C_{27}, C_{31}, C_{32}), showing that the odd and even series are represented by two distinct straight line characteristics. The soaps of the fatty acids, obtained by the action of the acid on a sheet of lead, give very intense spectra characterising the soap of the acid employed. The variation of the length of the chain as a function of the number of CH_2 groups is very regular—verified from acetic acid up to the acid having C_{32}. In this manner a length up to 92 Å.U. has been measured by an X-ray method. It is shown that the X-ray method is very suitable for analysis and identification of numerous organic substances. The author also claims to have followed, for the first time, by X-ray spectrography, the actual progress of a chemical reaction (oxidation of a non-saturated fatty acid in contact with lead) by obtaining photographically the progress *in situ* of the molecular changes taking place. A. B. W.

2873. *Compton-Effect in an Extended Scattering Body.* **B. Rajewsky.** (Zeits. f. Physik, 37. 9. pp. 699–700, 1926.)—The change of wave-length was a multiple of the Compton constant. The data point to a multiple scattering corresponding to a multiple Compton-effect. A. D.

2874. *The Compton and Photoelectric Effects for Polarised X-Rays.* **F. Kirchner.** (Phys. Zeits. 27. pp. 385–388, June 15, 1926.)—The usual action of X-rays on matter consists in the absorption of the original incident energy and its transformation into kinetic energy of electrons and potential energy of atoms according to the well-known equation $\frac{mv^2}{2} = h\nu - A$. Since the discovery of the Compton-effect it is found that an electron may be removed from an atom and set in motion by a scattering process and by the use of the laws of the conservation of energy and momentum $\frac{mv^2}{2} = \frac{2h^2\nu^2 \sin^2 \theta/2}{mc^2 + 2h\nu \sin^2 \theta/2}$, where θ is the angle between the incident and the scattered radiation. These relations give the amounts of energy which an electron can abstract from an incident quantum of given frequency. The polarisation of this quantum is so far not involved, but the question arises, "How does the motion of the electrons set free on absorption or scattering depend on the state of polarisation of the radiation?" The paper describes the attempt to answer this question experimentally. W. V. M.

2875. *Soft X-Rays.* **F. Holweck.** (Comptes Rendus, 182. pp. 1337–1339, May 31, 1926.)—The paper discusses various critical remarks made recently by Dauvillier [see Abstract 2122 (1926)] relative to the publications of the author. [See Abstract 1593 (1926).] A. B. W.

RADIOACTIVITY.

2876. *Absorption of the Penetrating Radiation of Actinium in Equilibrium with its Derivatives.* **Frilley.** (Comptes Rendus, 182. pp. 1461–1463, June 14, 1926.)—The absorption curve in Al is abnormal and the curve for $\log i = f(x)$, which starts as a straight line, increases its slope, and continues as a second straight line after 1·5 mm. thickness of Al. Similar anomalies are observed of the same form with various penetrating radiations, but always for very small thicknesses of the absorbers. It is shown that the phenomenon is not due to diffusion, as supposed by Hahn and Meitner; it is rather the result of the structure of the preponderating radiation, that of AcC_1'', which consists of a small number of lines. The first straight portion of the curve seems to result from the superposition of the normal curvature due to the limited range of groups of very homogeneous rays, and the effect of normal filtration acting on the softest rays. When the radiation is first filtered through 0·5 mm. of Ag, the curve in Al shows only one straight line, coinciding with the second part of the ordinary curve in Al. By deducting from the observed intensities that due to the γ-rays, and using the second straight line, the value $\mu = 44 \cdot 5$ cm.$^{-1}$ is obtained. The uncorrected value is 34·0. Experiments were also made with C, Cu, Ag and Au as absorbers. H. N. A.

2877. *Radioactivity and Chemical Composition of the Mineral Waters of Hammam des Ouled Ali.* **Pouget** and **Chouchak.** (Comptes Rendus, 182. pp. 1480–1481, June 14, 1926.)—The five thermal springs of Hammam des Ouled Ali are in the department of Constantine, 12·4 km. to the north-east of Guelma. Only one of these springs is utilised; its temperature is about 44·5° C., resistivity 733 ohms at 18° C., and it contains 28·2 millimicro-curies of radium emanation. The paper contains the results of a complete chemical analysis of the water of this spring. A. B. W.

2878. *The Action of Sunlight on the Radioactivity of Polonium and Lead.* **(Miss) S. Maracineanu.** (Comptes Rendus, 183. pp. 345–347, Aug. 2, 1926.)—A deposit of a solution of polonium on a sheet of lead 0·1 mm. thick gives a feeble ionisation current which increases daily. The effects are considerably increased by exposure to the sun, the current reaching, at the end of twenty-five days, a maximum, which is seven times the value at the end of the first day after exposure. The curve of growth closely resembles the theoretical curve of the formation of polonium (RaF) from RaE, which appears to indicate that the solar rays provoke the re-integration of RaE from RaF. Moreover, polonium which has been exposed to the sun's rays appears more brilliant to the screen than that which has not been exposed, and the photographic impressions much stronger. [See Abstract 761 (1926).] E. T. A. R.

2879. *Preparation of Sources of RaB and RaC.* **H. Jedrgejowski.** (Comptes Rendus, 182. pp. 1536–1539, June 21, 1926.)—The author describes two methods of preparing small and intense radioactive sources of RaB + RaC. In the first method the active deposit is concentrated by means of an electric field on a surface of appropriate shape. In the second method the radium emanation is condensed on a metallic surface by means of liquid air. The former method is not very efficient, a yield of only 28 % being obtained from 38 milli-curies of emanation on a surface 1·3 mm. diameter. The method of condensation of emanation by liquid air is more satisfactory, a special form of emanation apparatus having been constructed for the purpose. A. B. W.

2880. *Radiation from Radium.* **J. S. Lattès.** (Ann. de Physique, 6. pp. 102–182, July–Aug., 1926.)—A method is described for the analysis by absorption of the complex β- and γ-radiation from radium in principal groups, each of these groups being characterised for a given substance by the mass absorption coefficient μ/ρ, independent of the superficial mass of the screen traversed by the radiation. The secondary β-radiation excited in the screens by primary γ-radiation has been studied and a theoretical formula deduced which is in agreement with observations. The *quality* of this secondary radiation is dependent on the wave-length of the primary γ-radiation, but the *quantity* is dependent only on the nature of the absorber and, of course, on the intensity of the primary γ-radiation. All the principal groups of secondary β-rays obtained in this way conform to the linear law $\mu/\rho = a + h\mathrm{N}$. A. B. W.

2881. *Ionisation by RaEm in Spherical Vessels.* **W. Mund.** (J. Phys. Chem. 30. pp. 890–894, July, 1926.)—Assuming Geiger's law, formulæ and numerical tables are deduced for the number of ions which are produced in a spherical vessel by the α-rays from a given amount of radium emanation in equilibrium with RaA and RaC wholly deposited on the walls. A. B. W.

2882. *The "Bragg" Curve for the α-Rays from RaC′.* **Irène Curie** and **F. Béhounek.** (J. de Physique et le Radium, 7. pp. 125–128, April, 1926.)—The curve which represents the variation of ionisation along the track of a parallel beam of α-rays, called "the Bragg curve," has been studied by many investigators for various groups of α-rays. The authors have now constructed the Bragg curve for the α-rays of RaC′ in air by means of a new form of apparatus which presents certain advantages from a theoretical point of view over apparatus used by other investigators. The form of the curve obtained differs notably from that given by Henderson [see Abstract 580 (1922)]. The range extrapolated from the ionisation curve, 6·96 cm. in air at 15° C. and 760 mm. Hg pressure, is in good agreement with the value obtained by Henderson and by Geiger. A. B. W.

2883. *Nucleus of Helium Atom or α-Particle.* **H. Nagaoka.** (Imp. Acad. Tôkyô, Proc. 2. pp. 204–207, May, 1926. In English.)—Suggests that instead of being built up of four protons and two electrons, as in the accepted theory, the α-particle may consist of two protons, or "quanta" of positive electricity, which have coalesced to form a sphere of the same radius as that of a single proton. If the mass is entirely electromagnetic, that of such a sphere will be four times that of a proton. H. N. A.

2884. *Influence of Metallic Screens on α-Ray Ionisation Curves.* **Consigny.** (Comptes Rendus, 182. pp. 1614–1616, June 28, 1926.)—The effect of screens of Ag, Al, and Au has been tried, with screens of both single and double sheets. The deformation of the ionisation curves by these metals is in the order given, Ag producing the greatest effect. Neither Bianu's proportionality law [see Abstract 1679 (1913)] nor the systematic augmentation of deformation with atomic weight is confirmed. F. S.

2885. *Scattering of α-Particles through Small Angles.* **D. C. Rose.** (Roy. Soc., Proc. 111. pp. 677–690, July 2, 1926.)—Measurements have been made of the single-scattering of α-particles through angles from 1·2 degrees to over 8 degrees, using gold as the scattering material. The curves of scattering indicate that the nuclear field obeys the inverse law fairly closely for distances from $0{\cdot}4 \times 10^{-10}$ cm. to $1{\cdot}7 \times 10^{-10}$ cm. from the nucleus. Other experimenters (Rutherford and Chadwick) have shown that the inverse square law of force holds up to $3{\cdot}2 \times 10^{-12}$ from the nucleus. The results of the present experiments are not sufficiently accurate to detect any shielding effect due to the K shell of electrons. The curves indicate that this shell is not ionised to any appreciable extent. Wentzel's criterion for single scattering has been extended. The effect is practically all due to single scattering when the scattering angle ϕ is not less than 10ω, where ω is the angle of single scattering corresponding to $p = \sqrt{\frac{2}{\pi n t}}$. A. B. W.

2886. *Electromagnet for Use with a β-Ray Spectrograph.* **L. F. Curtiss.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 73–81, July, 1926.)—Considerations of the requirements of the spectrograph show that the magnet should produce a field of 5000 gauss, uniform to 1 part in 1000 over a circle at least 15 cm. in diameter. The enclosed yoke design was selected and Armco iron chosen for the core. The pole pieces are 24 cm. in diameter and the coils about 27 cm. long and wound with 2500 turns of No. 10 enamel and cotton-covered wire. The method of testing the magnet by a flip coil and the details of the β-ray spectrograph itself are also described. F. S.

2887. *Mode of Radioactive Disintegration accompanied by Secondary β-Ray Emission.* **S. Kinoshita, S. Kiuchi** and **Y. Hagimoto.** (Imp. Acad. Tôkyô, Proc. 2. pp. 195–197, May, 1926. In English.)—A study has been made by the Wilson expansion-chamber method of the mode of disintegration of single radioactive atoms, with the object of distinguishing individual atoms emitting more than one β-particle on disintegration. Careful examination of 81 sets of photographs gives the result, $N_{\beta} = 24$, $N_{\beta\beta} = 6$, $N_{\alpha\beta} = 65$, $N_{\alpha\beta\beta} = 8$, which leads to the conclusion that the fraction of disintegrating atoms giving rise to secondary β-rays is about 0·2 for RaB and 0·1 for RaC, a result in agreement with those of Moseley, Chadwick and others. It is emphasised, however, that the present results are based on observations of individual atoms, whereas those of previous observers are based on a statistical average. A. B. W.

2888. *Absorption of β-Rays by Matter.* **G. Fournier.** (Comptes Rendus, 183. pp. 200–203, July 19, 1926.)—In previous papers elements, chiefly metals, have been studied [see Abstracts 779 and 1055 (1926)]. Certain compounds can be split or cast so as to form thin sheets, and others have been powdered and used in troughs with thin bottoms, or, in the case of liquids, placed in glass vessels with thin parallel sides. These could also be used in an indirect determination, using solutions of varying concentration. If A_mB_n is a compound, and $(\mu/\rho)A$, $(\mu/\rho)B$ are the mass coefficients of absorption of A and B, which, with the exception of sulphur, can be calculated from the formula $\mu/\rho = 15 + 0{\cdot}142\ N$, then for normal compounds the mass coefficient of absorption for RaE β-rays is very near that obtained from the additive formula $\mu/\rho = \{mP_A(\mu/\rho)_A + nP_B(\mu/\rho)_B\}/M$, where P_A and P_B are the atomic weights of the elements and M the molecular weight of the compound. This law seems to hold for anhydrous compounds, except some which contain abnormal groupings. Water is abnormal. H. N. A.

HEAT.

2889. *Dilatometric and Thermal Properties of Glasses composed of Sodium Silicate.* **M. O. Samsöen.** (Comptes Rendus, 183. pp. 285–286, July 26, 1926.)—The properties are examined of glasses composed of varying proportions of SiO_2 and Na_2O. The coefficient of dilatation is found to be a minimum for a composition of 56 % SiO_2, which corresponds to the compound $SiO_2 . Na_2O$. The transformation temperature is at a maximum for the composition $2SiO_2 . Na_2O$, while minima, which are attributed to eutectics, occur with compositions on either side of this proportion. It is concluded that the only definite compounds in these glasses are SiO_2, Na_2O and $2SiO_2Na_2O$. J. N. P.

2890. *Measurements on the Thermal Expansion of Fused Silica.* **W. Souder** and **P. Hidnert.** (Bureau of Standards, Sci. Papers, No. 524. pp. 1–23, 1926.)—This paper gives the results of an investigation on the thermal expansion of transparent and non-transparent fused silica for various temperature ranges between − 125 and + 1000° C. A total of 48 expansion tests were made on 17 samples of fused silica. A detailed description of the apparatus and the methods used in this research and a summary of available data obtained by previous observers on the thermal expansion of fused silica are given. A critical temperature or minimum length was found at about − 80° C. Expansion occurred on heating fused silica above the critical temperature or cooling below this temperature. The coefficients of expansion of the transparent samples differ slightly from the coefficients of the non-transparent samples. Typical expansion curves are shown and discussed. The authors' average expansion curve is compared with the results of previous investigators. The table in the summary gives a *résumé* of average coefficients of expansion derived from the data on all samples for various temperature ranges between 20 and 1000° C. AUTHORS.

2891. *The Specific Heat of Iron-Nickel Alloys.* **M. Kawakami.** (Tôkyô Univ. Sci. Reports, 15. pp. 251–262, May, 1926. In English. Report No. 123 from the Research Inst. for Iron, Steel and other Metals.)—It is shown that in alloys containing up to 50 % of nickel the structure is nickel ferrite, martensitic or austenitic dependent upon the heat treatment, and that the specific heat varies accordingly. The specific heat of alloys containing more than 50 % of nickel remains unchanged by heat treatment, and the structure is austenitic throughout. The experimental results show that the specific heats of nickel ferrite, martensite and austenite stand in the relationship $C_{Au} < C_{NiFe} > C_{Ma}$. Corresponding to the rapid increase of thermal expansion above and below 36 % of nickel, the specific heat also decreases conspicuously on both sides of this percentage. In annealed alloys the specific heat increases with increase of the nickel content up to 10 %, after which martensite is present with the nickel ferrite, and the specific heat value is lowered. A further addition of nickel creates austenite, and the specific heat increases. There is a minimum value in the specific heat/concentration curve at 22 % and a rapid increase to a maximum value at 36 % nickel content. The heat treatment of the alloys was (*a*) simple annealing, (*b*) annealing and cooling in liquid air, and (*c*) annealing and quenching in water. The variation of the specific heat/concentration curve resembles the inverse of the expansion coefficient/concentration curve. S. G. B.

2892. *Specific Heats of Oils.* **A. R. Fortsch and W. G. Whitman.** (Indust. and Engin. Chem. 18. pp. 795–800, Aug., 1926.)—By measuring the temperature-rise produced by the introduction into a given quantity of oil of a definite amount of electrical energy, the specific heats of fifteen different petroleum oils are determined over temperature intervals ranging from 50° F. to 430° F. The equation $C = (t + 670)(2{\cdot}1 - S)/2030$, where C = specific heat, t = temperature (degrees Fahrenheit), and S = specific gravity of the oil at 60° F., expresses the results with an average deviation of 2·3 % at 240° F. for oils whose specific gravity at 60° F. varies from 0·75 to 1·00. This result is in good agreement with the average of other specific heat data available in the literature both at 60° F. and at higher temperatures. A. B. C. L.

2893. *Measurement of Surface Temperatures. Part I. A Portable Thermocouple Device Compensated for Heat Losses.* **M. W. Boyer and J. Buss.** (Indust. and Engin. Chem. 18. pp. 728–729, July, 1926.)—Measurement of surface temperatures may be made by the embedded thermocouple, thermocouple and thermometer pads, and the radiation method. The embedded thermocouple is the most accurate, but is limited in its application. The thermocouple pad usually consists of one or more couples backed by an insulating pad. The radiation method is of little practical value, owing to lack of information of black-body coefficients of the radiating surface, or the alternative necessity of calibrating the instrument for each surface. The authors have therefore developed a device for overcoming the principal objection to the thermocouple pad method, namely that the heat losses from the couple are usually sufficient to prevent the couple from attaining the true temperature of the surface. The device consists of two thermocouples in the form of discs, insulated from each other by mica. One of these discs is placed in contact with the hot surface, and the other, immediately above it, can be heated by means of a small heating coil near it, until both discs are at the same temperature. When this is the case, since no heat is then being lost from the surface to the discs, the reading is taken to be the true temperature of the surface. As the instrument is designed for temperatures up to only 140° C., couples of chromel-copel are used. T. B.

2894. *A New Method for the Measurement of the Temperature of the Earth.* **W. Schmidt.** (Zeits. Instrumentenk. 46. pp. 431–433, Aug., 1926.)—A description of an experimental method for the measurement of the temperature of the earth, for which it is claimed that it gives the actual temperature without time lag on the instruments, and the temperatures at various depths with exact definition of these depths by means of simple handling and with continuous control. A thermojunction and a galvanometer are utilised to give the temperature at the inner wall of a glass tube 7 mm. in external diameter and ½ mm. thick. The tube is forced into the earth at various depths by an iron boring arrangement.

The thermojunction is made to correspond at each depth with a similar instrument on the earth's upper surface. This quick-working method allows the different conditions down below to be followed intimately. The full experimental directions are given. S. G. B.

2895. *A Bath for Observations at Lower Temperatures.* **W. H. Patterson.** (Phil. Mag. 2. pp. 383–384, Aug., 1926.)—A Dewar flask is nearly filled with alcohol and provided with a stirrer; a tube, partly filled with cotton-wool into which liquid air can be blown in any desired quantity from another Dewar flask arranged as a wash bottle; and another tube to contain the liquid under observation and a thermometer. A resistance coil of eureka wire is immersed in the alcohol and serves to raise the temperature at a slow rate when needed. The apparatus is stated to be suitable for the determination of "setting points" of liquid as a test for purity. T. B.

2896. *Some Defects of Clinical Thermometers.* **B. Noyes, Jr.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 223–228, Aug., 1926.) —A note on the construction and use of clinical thermometers. The precise function of the constriction in the bore is investigated by a photomicroscopic method. It is shown that in the majority of cases the mercury in the stem rises discontinuously and is increased by small definite increments. The effects of gravity and surface-tension are held responsible for this and are investigated experimentally. Gravity has a very small influence. Notes are given on methods of calibration, and it is stated that the accuracy should be within 0°·2 F. throughout the scale. The calibration for the "retreat" test is discussed, and the importance of a standard rate of cooling in such tests is emphasised. S. G. B.

2897. *Measurement of the Heat of Wetting of Activated Carbon with Liquids.* **K. Andress** and **E. Berl.** (Zeits. phys. Chem. 122. pp. 81–87, July 13, 1926.)—This paper contains a full description of the calorimetric installation employed for the measurement of the heats of wetting several forms of activated carbon with water, ether, benzene, carbon bisulphide, ethyl and methyl alcohols, and tetrachlorethylene. From the data obtained and recorded in the paper a gramme of active carbon affords 12·35 cal. when wetted with water and about 30 cal. when wetted with the above organic liquids. H. H. Ho.

2898. *The Ageing of Thermometer Glass.* **L. Holborn** and **J. Otto.** (Zeits. Instrumentenk. 46. pp. 415–424, Aug., 1926. From the Reichsanstalt.)—Different specimens of Jena thermometer glass, including supremax glass, which can be used for thermometers reading up to 650° C., were investigated to find the conditions which would age them most rapidly, various heat treatments being applied until the length of the specimen was not altered when it was heated from 30° well above the highest temperature at which a thermometer made of the glass would be used and down again to 30° C. As a result of these experiments it appears that the best method for ageing the glass of a thermometer is to heat the fully prepared bulb and stem for three hours 20° to 30° above the commencement of the critical zone, where a sudden large increase in the coefficient of expansion takes place. The glass should then be slowly

cooled down, about the same period being employed for this process, and kept for six hours at the softening-point. The way in which it is afterwards cooled down to room-temperature is without much influence. At the higher temperature mentioned above the glass has still sufficient toughness to keep its form without any marked deformation due to its weight, but instruments with thin-walled bulbs should be hung up and not allowed to rest on the bottom of the oven. Experiments were also made with short pieces of the tubes, with polished ends, which were subjected to heat treatment between crossed nicols, and these showed how the internal stresses of the glass were altered by the treatment.
H. N. A.

2899. *Isothermal Calorimetry.* **H. v. Wartenberg and B. Lerner-Steinberg.** (Zeits. phys. Chem. 122. pp. 113–120, July 20, 1926.)—The greatest error in calorimetry has usually been that caused by the top not being closed in. T. W. Richards has overcome this difficulty with the adiabatic calorimeter, and the author endeavours to use a calorimeter in an isothermal manner by arranging to take heat out at the same rate at which heat is generated. If this can be done, the water equivalent of the calorimeter need only be known approximately, and the thermometer will be used as a null instrument. In order to obtain a sufficiently rapid exchange of heat in the calorimeter, it was found desirable to use ammonium nitrate, which has a large negative heat of dilution. The heat of dilution depends on (1) the temperature, (2) the end-concentration, (3) the initial-concentration. The solution, made up to a suitable strength, is allowed to drop or to be forced from a copper vessel contained in the calorimeter into the water of the calorimeter so as to maintain a constant temperature. If the temperature of the surroundings is kept constant to 0·1° C. and the water equivalent of the calorimeter is known to 5 %, a heat determination to 1 % can be made with an open calorimeter. The paper gives details for preparing and standardising the calorimeter. [See next Abstract.] T. B.

2900. *Heat of Dilution of Ammonium Nitrate.* **B. Lerner-Steinberg.** (Zeits. phys. Chem. 122. pp. 121–125, July 20, 1926.)—This paper describes the determination of the heat of dilution of ammonium nitrate, as the results of Thomson are not sufficiently accurate to allow a heat determination to 1 % to be made. This was the accuracy desired by the author in the previous paper [see preceding Abstract]. The measurement was made by compensating the heat of dilution by a measured amount of electrical energy. The heating spiral was of manganin and was protected by a brass tube. The heats of dilution of 1 mol. of NH_4NO_3 and 2·5 mols. of water (64·00 % NH_4NO_3) to a solution of 1 mol. of NH_4NO_3 to *m* mol. of water, where *m* varied from 79·8 to 234, are tabulated. The temperatures were 18·2° C., 21·6° C., and 25° C. Using Kirchhoff's result, $C_{\text{dilute sol.}} = \frac{d\phi}{dt} + C_{\text{water}} + C_{\text{concentrated sol.}}$, the author calculates C for the dilute solution and finds a good agreement with the experimental results. The heat of solution is found to have a large temperature coefficient. T. B.

2901. *Vapour-Pressure of Anhydrous Oxalic Acid.* **W. A. Noyes, Jr., and D. E. Wobbe.** (Am. Chem. Soc., J. 48. pp. 1882–1887, July, 1926.)—

Preliminary experiments are described which illustrate the difficulties in determining accurately the vapour-pressure of anhydrous oxalic acid arising from its instability at temperatures ranging from 120° C. to 170° C. and from its complex modes of decomposition. Ultimately a dynamic method is adopted, the acid being evaporated into a stream of pure dry nitrogen. The values obtained for the vapour-pressure between 60° C. and 105° C. are found to be satisfactorily represented by the equation $\log p = -(4726\cdot9499/T) + 12\cdot22292$. It is suggested that the specific heat of the vapour might be expected to be only slightly different from that of the solid. The heat of sublimation as given by the equation would be 21,650 calories per mol. A. B. C. L.

2902. *Rate of Flame Propagation in Gaseous Explosive Reactions.* **F. W. Stevens.** (Am. Chem. Soc., J. 45. pp. 1896–1906, July, 1926.)—A description is given of a device by which mixtures of carbon monoxide and oxygen contained in a soap-bubble are exploded from the centre of the bubble, the rate of progression of the flame being recorded by photographic methods. The record obtained gives the initial volume of the active components of known concentrations, and, at the instant the reaction is completed, it gives the volume of the equilibrium products which is the volume corresponding to the reaction constant

$$K = [A]^{n_1} . [B]^{n_2} . [C]^{n_3}/[A']^{n'_1} . [B']^{n'_2} . [C']^{n'_3}.$$

The concentrations of the explosive gases that the flame is entering remain constant under the condition of constant pressure, and it is found that the flame velocity remains constant under these conditions, its value, S, being proportional to the product of the initial concentration of the gases, $s = k_1[A]^{n_1} . [B]^{n_2} . [C]^{n_3}$. A. B. C. L.

2903. *Influence of Pressure on the Formation of the Explosive Wave.* **P. Dumanois** and **P. Laffitte.** (Comptes Rendus, 183. pp. 284–285, July 26, 1926.)—Mixtures of hydrogen and oxygen in equivalent proportions and at varying pressures are admitted to a glass tube 1 m. long and 22 mm. internal diameter, and, after igniting by an electric spark, a photographic record is made on a moving film which shows the length of tube traversed by the flame from the ignition of the detonating mixture to the setting up of the explosive wave. The interval falls with increasing initial pressure of the gas mixture, at first rapidly and then more slowly, and ranges from a value of 70 cm. at atmospheric pressure to 27 cm. at a pressure of 6·5 atmospheres. J. N. P.

2904. *Supplement to B. Baule's "Theoretical Treatment of the Phenomena in Rarefied Gases."* **T. Sexl.** (Ann. d. Physik, 80. 5. pp. 515–523, July 13, 1926.)—Baule [see Abstract 1308 (1914)] has treated mathematically the various phenomena peculiar to highly rarefied gases and to a very exact order of accuracy. The present paper is a supplement to this work, and deals with the exact theory of the absolute manometer according to the Baule method. H. H. Ho.

2905. *The Vapour-Pressure of Solid Sodium and Solid Potassium Amalgams.* **F. E. Poindexter.** (Phys. Rev. 28. pp. 208–228, July, 1926.)—The vapour-pressure of eight sodium and three potassium amalgams of concentrations ranging from 1Hg : 1Na to 1Hg : 15Na and from 5Hg : 1K to 21Hg : 1K were measured over ranges of temperature between − 57° C. and 91° C. in the former case and − 24° C. and 11° C. in the latter by means of a modified Buckley ionisation gauge. The materials used were purified and carefully outgassed in specially designed apparatus. The recorded pressures varied from 10^{-8} mm. to 10^{-3} mm. over the above temperature range, and the log P : 1/T curves were rectilinear. The heats of reaction calculated from the Van't Hoff isochore varied only slightly (15,000 cals. for Hg rich to 14,000 cals. for Na rich amalgams), indicating that most of the heat is liberated in the formation of the initial compounds. The heat of reaction of potassium amalgams was 25,500 cals. The internal energy change as calculated from the log P : 1/T curves was greater in the case of the potassium amalgams than the free energy change as calculated by R. H. Gerke, while that of sodium amalgams was less. This latter is corroborated by the work of Richards and Conant [see Abstract 1809 (1922)]. The efficiency of sodium mercury-vapour traps is discussed, and it is shown that the time necessary for sufficient mercury to diffuse through 100 cm. of tubing of 1 sq. cm. cross-sectional area to raise the vapour-pressure over 10 grammes of sodium to 3×10^{-8} mm. is 1500 days at 20° C. T. B.

2906. *Temperature Stresses and Deflections in the Fins and Barrel of an Air-cooled Internal-Combustion Engine Cylinder.* **A. M. Binnie.** (Phil. Mag. 2. pp. 449–462, Aug., 1924.)—A theoretical paper in which the temperature variations and consequent stresses and deflections in an air-cooled internal-combustion cylinder are calculated by assuming that the hot cylinder loses its heat by radiation only, and that the cooling fins are of such thinness that for points equidistant from the cylinder axis the stresses and shift are constant. The cases of fins of constant and of varying thickness are considered, and numerical examples are given which indicate the order of the stresses developed and show that the fins can be reduced in thickness towards the tips without serious change in the stresses or diminution of the cooling power. The distribution of stress in the cylinder barrel is also considered, and it is shown that the distortion becomes less the more closely the fins are spaced, and that the temperature stresses in the fins augment to a small extent the resistance of the barrel towards internal pressure. T. B.

2907. *Investigation of the Effects of Variations in the Radiation Factor on the Efficiency of Dewar Vessels.* **B. Lambert** and **K. T. Hartley.** (Roy. Soc., Proc. 112. pp. 136–151, Aug. 3, 1926.)—The anomalous behaviour of copper-surfaced Dewar vessels whereby the rate of evaporation of liquid oxygen is greater while the rate of cooling of hot water is less than in similar vessels with silver surfaces is confirmed by experiments made with specially designed vacuum vessels whose surfaces were capable of accurate reproduction. The action of Dewar vessels is discussed theoretically, and expressions for the rate of heat transfer deduced from the laws of Stefan and Wien and the work of Maxwell, Haagen and Rubens. These deductions are found to be incapable of explaining the anomalous behaviour of copper surfaces, and the authors propose a theory depending upon atomic resonance frequencies, and show that since the characteristic frequency of copper is much closer to the wave-length of maximum energy in black-body radiation at the temperature of liquid oxygen than those of silver, gold or platinum the emissivity for this wave-length will be abnormally greater. At the temperature of hot water this difference largely disappears. The efficiency of copper vacuum vessels is shown to be increased by silvering the vacuum adjacent surfaces. T. B

2908. *Spectral Emissivities of Tantalum, Platinum, Nickel and Gold as a Function of Temperature, and the Melting-Point of Tantalum.* **A. G. Worthing.** (Phys. Rev. 28. pp. 174–189, July, 1926.)—The spectral emissivities of Ta at 0·665 μ and 0·463 μ have been determined by (*a*) the tubular filament, (*b*) the reflectivity, and (*c*) the comparison at contact methods. For 0·665 μ the smoothed values at 300° K., 1500° K. and 2700° K. are 0·493, 0·438 and 0·394; for 0·463 μ, 0·56, 0·50 and 0·43. While agreeing at 300° K. with the results of Wartenberg and of Coblentz, at incandescence the present values are lower than previous values. Probable sources of error in emissivity determinations are such as to indicate that these lower values are the more reliable. For 0·665 μ the above emissivities lead to the following differences between brightness temperature and true temperature as a function of the brightness temperature: 57° at 1200° K., 107° at 1600° K., 179° at 2000° K., 278° at 2400° K., and 406° at 2800° K. Two determinations of the melting-point of Ta by the contact method, using tungsten as the known material, yielded 3300° K. This is higher than previously reported values.

The spectral emissivity of Pt was found to vary linearly with temperature. For 0·665 μ the emissivities at 1200° K. and 1850° K. are 0·295 and 0·310; for 0·535 μ at 1200° K. and 1600° K., 0·325 and 0·335; for 0·460 μ at 1600° K. and 1850° K., 0·375 and 0·390. The emissivity at 0·665 μ combined with an observed brightness temperature of 1842° K. checks Hoffman's careful melting-point determination exactly.

The spectral emissivity of Ni (98·8 % pure) was found not to change with temperature. For 0·665 μ, 0·535 μ, and 0·460 μ, emissivities of 0·375, 0·425, and 0·450 were obtained.

The spectral emissivity of Au for 0·665 μ was found to increase from 0·062 at 300° K. to 0·145 at 1300° K., for 0·535 μ to increase from 0·352 at 300° K. to 0·450 at 1300° K., for 0·460 μ to remain constant at 0·633.
AUTHOR.

2909. *The Equation of State of Solid Substances in Connection with the General Expression for the Energy. Part II.* **J. J. van Laar.** (K. Akad. Amsterdam, Proc. 29. pp. 497–514, 1926.)—In a previous paper [see Abstract 1612 (1926)] the author has established that the equation of state of solid substances must possess the form $p + a/v^2 = (\lambda + \mathrm{RT})/(v - b)$, and he now proceeds to the solution of the more general problem as to the form of the equation of state at somewhat lower temperatures when the progressive energy of the molecules slowly begins to degenerate. § 1 considers the equation of energy at higher temperatures where $\mathrm{L} = 3\mathrm{RT}/2$ is replaced by Debye's expression, $\mathrm{L} = 3/2\mathrm{RT}(1 + \theta^2/20\mathrm{T}^2 - \theta^4/1680\mathrm{T}^4 + \ldots)$. § 2 deals with the equations of energy and of state at higher temperatures. § 3 is devoted to the calculation of the terms $\mathrm{A} = \theta_0^2\phi_1/20$ and $d\mathrm{A}/dv$ at higher temperatures. § 4 investigates the equations of energy and state at very low temperatures. Here the Debye expression above is replaced by $\mathrm{E}_t = 9\mathrm{R}\theta_0/8 + 3\mathrm{R}\pi^4\mathrm{T}^4/\theta^3$, where E_t represents the temperature part of the energy. The paper is entirely mathematical. H. H. Ho.

2910. *Elasticity Coefficients and Integration Factor for the Solid State.* **A. Press.** (Phil. Mag. 2. pp. 431–436, Aug., 1926.)—Starting from the energy equation $dQ = \frac{\partial U}{\partial t}dt + \left(\frac{\partial U}{\partial v} + p\right)dv$, and assuming an integrating factor $\mu = f(v, t)$, it follows that

$$\frac{\beta}{k_T} = \frac{\frac{\partial \mu}{\partial v}}{\mu}\frac{\partial U}{\partial t} - \frac{1}{\mu}\frac{\partial \mu}{\partial t}\left(1 + \frac{p}{\frac{\partial U}{\partial v}}\right)\frac{\partial U}{\partial v},$$

where β is the coefficient of expansion, and k_T is the isothermal compressibility. At temperatures removed from the change of state, the $\frac{\partial U}{\partial t}$ term predominates, so that $\frac{\beta}{k_T} = \frac{1}{\mu}\frac{\partial \mu}{\partial v}\frac{\partial U}{\partial t}$. Dulong and Petit's law gives $\frac{\partial U}{\partial t} = \frac{6 \cdot 6}{Vd}$, V being the atomic volume and d the density, so that Grüneisen's specific heat condition, $\frac{\beta}{k_T} = A\frac{\partial U}{\partial t}$, follows if $\frac{1}{\mu}\frac{\partial \mu}{\partial v}$ is *a constant*, and not zero as usually assumed. At a change of state the other term predominates, so that, practically, $\frac{\beta}{k_T} = -\lambda\frac{1}{\mu}\frac{\partial \mu}{\partial t}$, λ being the internal heat per unit volume. In the case of gases, with $\mu = \frac{1}{t}$, we have at once the Edser-Lewis latent heat formula. W. G. B.

2911. *Entropy of Amorphous Substances.* **F. Simon** and **F. Lange.** (Zeits. f. Physik, 38. 3. pp. 227–236, 1926.)—This paper gives the results of measurements made at low temperatures (between 10° and 13° abs.) on the specific heat of glass and glycerine, the object of the experiments being to calculate the difference between the entropy in the amorphous and crystalline states at the absolute zero of temperature without the necessity of having to extrapolate to such a degree as had been done previously by Wietzel, and also by Gibson and Giauque. The curve between atomic heat and temperature for amorphous glycerine shows a sharp bend at 180° abs. with a large increase in atomic heat. This sudden jump in the curve agrees with the break in the curve of the dielectric constant as found by Dewar and Fleming, which also took place at 180°. Below 180° amorphous glycerine is a hard stony substance. Speculation as to the vibration of the atoms in the molecule are made in order to explain the form of the curve. The authors conclude that the entropy of the supercooled melt at absolute zero exceeds that of the crystalline phase by 0·9 ± 0·3 cal./degree per molecule in the case of glass, and by 4·6 ± 0·3 cal./degree per molecule in the case of glycerine. T. B.

SOUND.

2912. *Melde's Experiment.* **A. T. Jones.** (Phys. Rev. 27. pp. 622–631, May, 1926.)—A theory is developed to explain the conditions governing the continuous rotation of the pulley that takes place in Melde's experiment, and is tested experimentally. Moderately good verification is obtained. G. A. S.

2913. *Acoustic Gas Analysis.* **W. Späth.** (Zeits. techn. Physik, 7. 7. pp. 355–356, 1926.)—It is suggested that the variation in pitch occurring when two forms of mechanical vibration are coupled may be utilised for the purposes of gas analysis. T. H. P.

2914. *The Transverse Vibration of Strings.* **Satyendra Ray.** (Phys. Rev. 28. pp. 229–231, July, 1926.)—The investigation of the velocity of propagation of transverse waves in strings is generally made under the assumption that the wave-form is very flat. It is shown here that the velocity is a function of the dimensionless quantity a/λ, where a is the amplitude of vibration and λ the wave-length. When a/λ is constant, or the waves are geometrically similar, the velocity of propagation is a constant, but not otherwise. AUTHOR.

2915. *Transmission and Absorption of Sound by Some Building Materials.* **E. A. Eckhardt** and **V. L. Chrisler.** (Bureau of Standards, Sci. Papers, No. 526. pp. 37–63, 1926.)—This paper contains a report of the work on sound transmission through partition walls and on the sound-absorbing properties of some of these walls and of various other materials commonly used in building construction. A description is given of the new sound-chamber erected for the purpose of this work; details of the experimental methods are described, and relative results of both transmission and absorption measurements are tabulated. These results are given for frequencies covering the range from 250 to 3470 cycles per sec. Specifications for the construction of the various panels used in transmission tests are appended. It is found that, as far as transmissivity goes, certain panels are sufficiently opaque to sound to reduce a sound of painful intensity to complete inaudibility. The poorest panels tested were capable of reducing such a sound to about the intensity of the ordinary speaking voice. AUTHORS.

2916. *Transmission of Sound through the Head.* **H. Banister.** (Phil. Mag. 2. pp. 144–161, July, 1926.)—A survey is made of the evidence for the assumption that air-borne sounds communicated to one ear in the normal manner can be transmitted through the head to the other ear. Experimental results of different workers are quoted, and evidence is given for and against the assumption, but no conclusion is reached. C. M. R. B.

2917. *Phase Effect and the Localisation of Sound.* **H. Banister.** (Phil. Mag. 2. pp. 402–431, Aug., 1926.)—A discussion of the hypothesis associated with the names of Myers and Wilson, that "phase effect" might be due to binaural differences of intensity brought about by bone conduction across the head. [See preceding Abstract.] Direct evidence is given against the assumption that ears are exceptionally sensitive to binaural differences of intensity produced by bone conduction, and a mathematical treatment leads to the same view. The conclusion is that any hypothesis is wrong which seeks to explain the facts of sound localisation by binaural phase differences on the assumption that there is transmission of sound from one ear to the other through the head, and that this transmission causes the actual intensity of the sound at the ear which leads in phase to be greater than the intensity at the ear which lags in phase. C. M. R. B.

2918. *Power of Fundamental Speech Sounds.* **C. F. Sacia** and **C. J. Beck.** (Bell System Techn. J. 5. pp. 393–403, July, 1926.)—Continues the work of previous papers [see Abstracts 338 and 339 (1926)] on speech power studied by means of oscillograph records of vowels, semi-vowels and consonants. Conversational relative values (averaged) of the mean power for each fundamental sound for sixteen speakers are shown in arbitrary units. Vowels rank highest, semi-vowels next, and consonants lowest, although a few consonants are interspersed among the semi-vowels. The original paper should be consulted. W. H. Gb.

2919. *Methods of High-quality Recording and Reproduction of Music and Speech, based on Telephonic Research.* **J. P. Maxfield** and **H. C. Harrison.** (Bell System Techn. J. 5. pp. 493–523, July, 1926.)—The problem is divided up into (*a*) the study of the character of the sounds to be recorded, (*b*) the recording apparatus and material, and (*c*) the intervening system by means of which the sound waves make the record. By controlling the acoustic properties of the room in which the sound is being recorded, it has been found possible to simulate the original space effects in reproduced music. In recording work, therefore, an important characteristic of a room is its time of reverberation; with single-channel systems of reception a time of reverberation of about three-quarters of a second is suitable. In connection with the frequency requirements a range from 60 to 6000 can be recorded with reasonable success. In some cases the harmonics may be present and the fundamentals absent, being below the minimum recordable frequency, but this does not prevent the listener from hearing the notes [see Abstract 1860 (1924)].

The use of high-quality electrical apparatus for recording purposes has several distinct advantages over the acoustic method. The system used for recording includes a condenser-transmitter [see Abstract 1162 (1917)], an amplifier and an electromagnetic recorder. These give remarkable uniformity over a wide range of frequencies. In addition, there is an indicator for measuring the power which is being delivered to the recorder, and an audible "monitoring" system with loud-speaker. The general basis of design consists in viewing the recording and reproducing systems as mechanical analogues of electrical circuits, and in the present development many valuable ideas have been obtained from the study of electric filters begun by G. A. Campbell (Phil. Mag., March, 1903). Mechanical and electrical analogues are set forth, and, as illustrations of the methods employed, portions of the reproducer system are worked out in detail, namely the air-chamber between the diaphragm and the horn, and the needle arm; and the equivalent electrical network to the reproducing system is built up. G. E. A.

2920. *A Self-starting Phonic Motor.* **D. C. Gall.** (Journ. Sci. Instruments, 3. pp. 351–352, July, 1926.)—A description of two and three stage phonic motors manufactured by H. Tinsley and Co. The exciting winding is constructed in annular sections with the circuit passing longitudinally through the outer casing, the teeth of the stator and teeth of the rotor, and back through the central ring to the outer casing. Quarter-phase contacts are employed to distribute the impulses more evenly throughout the cycle. A. W. L.

2921. *Detection of Icebergs and Depth-Sounding by Means of an Ultrasonic Beam.* **R. W. Boyle** and **C. D. Reid.** (Roy. Soc. Canada, Trans. 20, Sect. 3. pp. 233–243, Jan., 1926.)—The paper deals with the practical applications of ultrasonics for detection purposes in navigation, the reflectors under consideration being the hulls of steel ships, stone shores and submerged rocks, the sea-bed and icebergs. After dealing with the theoretical possibilities of the problem the paper goes on to deal with experiments carried out at sea. Two different types of electrically-operated ultrasonic transmitting and receiving instruments were employed—one the "pile of plates" and the other "two half-wave plates" (see La Nature, Jan. 8, and Aug. 20, 1921, and "Report on Ultrasonics to Canadian Research Council," April, 1922, for a description of these instruments). As a result of tests on shores and reefs it was considered ordinarily possible to obtain ranges (for definite echo reception) up to about 1000 yards. With regard to icebergs, the conclusion was drawn that they can be detected by an ultrasonic beam over a short range (200 to 300 yards) in deep water, but that the detecting effect is weak in comparison with that from steel ships or rocky shores. With regard to depth-sounding, the ultrasonic apparatus gave clear, strong and sharply-defined echoes from the sea-bed. An actual sounding of 350 yards agreed well with that taken by the Kelvin sounding-machine. It was found that the ultrasonic method of sounding was practicable at all depths over a few fathoms, the speed of the ship making no difference to the observations. It should be noted that the ultrasonic transmitter also acts as the receiver of the echo. The suggestion is made that the ultrasonic apparatus might also prove useful to ships entering harbours in fog, as a mean of locating the points of uncertainty or danger. A. B. W.

2922. *Reflecting Powers of Various Materials for Ultrasonic Waves.* **R. W. Boyle** and **G. B. Taylor.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 245–257, Jan., 1926.)—The paper considers theoretically and experimentally the reflection of extremely short sound waves (of the order of 1 cm. in length) in water from various materials, notably steel, granite and ice, the ultimate application of the information obtained being the detection of shores, shoals, hulls of ships and icebergs by ships at sea. In their description of the method employed (see also former papers, Trans. Roy. Soc. Can., Sect. III, p. 177 and pp. 194, 195, 1925, and Report on Ultrasonics to Canadian Research Council, April, 1922) the authors state: "If the exciting voltage is varied the energy emitted by the ultrasonic generator employed is proportional to the square of the voltage, the frequency remaining constant. Therefore by fixing the frequency of emission, and allowing the ultrasonic beam to fall perpendicularly on various reflectors and observing the minimum voltage of excitation at which standing waves will just be formed, a quantitative indication (not an exact measure) of the comparative strength of the reflected energies is obtained." The standing waves were observed on the floor of a tank by means of powdered-coal cinders (passing through a mesh of forty to sixty to the inch). The following table contains the principal results of the investigation :—

Material of Reflector (Medium of Propagation Water in all Cases).	Relative Energy to produce Standing Waves.	Ratio of Reflecting Power (calculated from ρV Relation).
Steel	1·0	1·0
Granite....................	0·69	0·82
Ice *	0·28	0·037 0·141

* Direction of optic axis of block of ice not determined.

The approximate nature of the results obtained is realised, but they yield useful indications of what may be expected in practical work at sea when an ultrasonic beam is used for detection purposes. A. B. W.

2923. *The Acoustic Impedance at the Sending End of an Exponential Horn of Finite Length.* **K. Kobayashi.** (Inst. El. Eng. of Japan, J. No. 455, pp. 601–611, June, 1926.)—The general equation of the velocity potential, which is satisfied in horns of various shapes, was given by A. G. Webster in 1919 as $\frac{\partial^2\phi}{\partial t^2} = v^2\left[\frac{\partial^2\phi}{\partial x^2} + \frac{d(\log a)}{dx}\frac{\partial\phi}{\partial x}\right]$. From this equation tho authors derive the acoustic impedance density at the sending end of an exponential horn of finite length. Its value is calculated assuming that the air membrane at the open end has an infinite rigid flange, and this calculated value is compared with the value which was obtained experimentally by the measurement of the motional impedance of a telephone receiver, coupled with an exponential horn. The theory and experiments are described in detail, and it is shown that the calculation of the acoustic impedance of the sending end of an exponential horn by this theory gives satisfactory results in a practical case. AUTHOR.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2924. *Application of Elliptic Functions to the Method of Electrical Images.* **C. N. Wall.** (Tôhoku Math. J. 27. pp. 176–188, July, 1926.)—The problem of determining the distribution of electric potential due to a linear charge within an earthed conducting rectangular tube of infinite length has been treated by J. Kunz, P. L. Bayley and C. M. Hebbert [see Abstract 1126 (1921)]. The solution can be expressed concisely in terms of the sigma functions. A somewhat similar problem of determining the potential distribution around a linear charge between two coaxial circular tubes of infinite length and at zero potential has been solved by J. Kunz [see Abstract 1192 (1923)]. In both of these problems the solutions were obtained by the method of electrical images. In the present paper the second of these problems is generalised. It is shown (1) that the solution of this generalised problem can be expressed in terms of the theta functions or of sigma functions, (2) that the generalised problem is a simple transformation of the first problem noted above. As subsidiary results there appear functions with multiplicative periods, and also an interesting relation between the sigma functions and the theta functions.

G. W. de T.

2925. *The Problem of the Spherical Condenser.* **A. Russell.** (Inst. El. Eng., J. 64. pp. 727–736, July, 1926.)—Methods are given of computing to any desired accuracy the capacity of a spherical condenser when the bounding spherical surfaces are not concentric. Methods of calculating the attraction on the inner sphere and the maximum potential gradient in the field between the two shells are given. The results obtained are of use in calculating the capacity coefficients of spherical electrodes. They are directly useful also when measuring by standard methods of the inductivity (specific conductive capacity), the thermal conductivity and the electrical conductivity of homogeneous substances. The complete solution of the problem, when the spheres are not concentric, is of practical importance, moreover, in that it is proposed to use effective pressures exceeding a million volts for testing purposes. It is therefore important to be able to calculate without excessive labour the attractions and repulsions between the spherical electrodes, whatever their potentials, and also the maximum value of the electric stress in the medium between them. For the author has shown [see Abstract 739 (1920)] that the problem of finding the capacity coefficients of spherical conductors can always be reduced at once to that of finding the capacities of certain spherical condensers. They can, therefore, always be found by the help of the formulæ given in this paper. The author has published [see Abstract 530 (1912)] solutions for the care of equal spherical electrodes. The new methods which he now gives, and further methods which he hopes to give in a subsequent paper on the problem of external spheres, will partly supersede the formulæ previously given.

G. W. de T.

2926. *Frictional Electricity.* **H. F. Vieweg.** (J. Phys. Chem. 30. pp. 865–889, July, 1926.)—The present investigation is undertaken with the following objects in view: (1) To arrange a frictional electric series of suitable materials; (2) to explain, if possible, from such a series how various factors determine the position a substance takes; (3) to learn what the effect of moisture is, and to what extent this may account for anomalies previously observed. A brief historical survey of the subject is given. Coehn's rule, which states that a frictional electric series of non-conductors from positive to negative corresponds to a series from highest to lowest dielectric constant, is considered. As a result of the study of the effect of moisture it is concluded that it is absolutely necessary to work in the absence of moisture if reproducible results are desired. Three curves showing the variation in charge on the gas with concentration of ionised HNO_3, $NaNO_3$, and NaHO are given. A. E. G.

2927. *Ebert's Atmospheric Electric Convection Current.* **W. Schmidt.** (Phys. Zeits. 27. pp. 472–473, July 15, 1926.)—Calculates the density of this current as less than $0\cdot 87 . 10^{-9}$ electrostatic units, to compare with the mean atmospheric conduction current, $7 . 10^{-7}$ units. A. D.

2928. *Ribbon Lightning.* **W. J. Humphreys.** (Frank. Inst., J. 202. pp. 205–206, Aug., 1926.)—Ribbon lightning is a more or less continuous discharge along the same lightning path for an appreciable length of time, and when photographed with a moving camera a ribbon-like picture is obtained with narrow cross-stripes. Often there are lengthwise stripes also, producing a plaid effect, due to variations in the current strength. An illustration of the phenomenon is given, and two causes of the bright cross-stripes are deduced which are usually more or less combined: (1) line-of-sight direction of portions of the path, giving the intensified end-on effects, and (2) movement of the eye, or camera, parallel to sections of the streak, causing superposition and thus intensification of their images. This also is considered to be an explanation of beaded lightning, a streak of disconnected spots and dashes. R. S. R.

2929. *Electromagnetic Perturbations and Solar Disturbances.* **A. Nodon.** (Onde Élec. 5. pp. 359–363, July, 1926.)—The propagation of electromagnetic waves appears to be closely connected with the state of ionisation and of conduction of the upper layers of the atmosphere. Atmospheric ionisation is apparently due to radiations of extreme penetrating power emitted by the sun and stars. The emission of these radiations undergoes profound modifications during solar disturbances, and this results in corresponding effects in wave propagation. A. W.

DISCHARGE AND OSCILLATIONS.

2930. *Small-Shot Effect and Flicker Effect.* **W. Schottky.** (Phys. Rev. 28. pp. 74–103, July, 1926.)—J. B. Johnson observed under certain conditions voltage fluctuations across connected resonant circuits which were much larger than the theory of the small-shot effect would lead one to expect. Analysing Johnson's curves, it is found that this effect increases as the square of the electron current i_0 instead of as the first power, as in the case of the small-shot effect. The trend with the natural frequency of the connected circuit is likewise different from that observed in the small-shot effect. The elementary atomic process underlying the flicker effect is the appearance of an individual foreign atom or molecule in the surface of the kathode, changing the ability of the surface to emit electrons so long as the foreign atom remains. The influence exerted upon the current by foreign atoms in the surface may be calculated with sufficient approximation from the electrical image theory and Langmuir's doublet theory. From the assumptions that the elementary atomic processes are independent of one another, and that the length of stay of the foreign atoms in the surface conforms to statistical laws, the frequency distribution of the flicker effect is derived and compared with Johnson's experiments, whence it is possible to determine the length of stay of the foreign atom in the surface. From calculations made it is inferred that the essential cause of the flicker effect with oxide kathodes lies in a continual exchange of positions by the components of the oxide. The variation of the flicker effect with the square of the total current follows from the assumption that the current change due to one foreign atom is proportional to the total current. From this assumption also follows the relative independence upon temperature. A value is given for the mean square voltage fluctuation produced by the effect in terms of the impedance of the connected circuit, and formulæ are given for circuits of various kinds. Measurements with two circuits, one being resonant and the other a pure resistance, should provide a definite check of the calculated length of stay of the foreign atoms. A. E. G.

2931. *Thermionic Phenomena caused by Vapours of Rubidium and Potassium.* **T. J. Killian.** (Phys. Rev. 27. pp. 578–587, May, 1926.)—Thermionic effects similar to those studied by Langmuir and Kingdon [see Abstract 1182 (1925)] have been found for rubidium and potassium. On account of the difference in the electron affinity of tungsten (4·53 volts) and that of an atom of rubidium or potassium (4·16 and 4·32 volts respectively) positive ions are formed which at filament temperatures above 1000° are drawn to the cylindrical collector from the coaxial filament. Below this temperature the ions are absorbed on the surface of the filament and decrease its work function, raising the electron emission. The degree of thermal ionisation at various filament temperatures is found to be within the experimental error of that determined from Saha's equation. At low temperatures the filament is partially covered by adsorbed ions, and the electron emission increases exponentially with the reciprocal of temperature. The positive ion emission increases logarithmically with the reciprocal of temperature until a certain fraction of the atoms striking the filament is ionised. The vapour-pressure of rubidium and potassium is calculated, for rubidium $\log p = 10\cdot 55 - 4132/T$ and for potassium $\log p = 11\cdot 83 - 4964/T$ (p in bars). A. B. W.

2932. *Motion of Electrons in Hydrogen and Helium.* **H. B. Wahlin.** (Phys. Rev. 27. pp. 588–595, May, 1926.)—Mobilities of electrons in H_2 and He at 760 mm. pressure have been measured by the Rutherford alternating potential method for fields ranging from 0·5 to 46 volts/cm. The limiting mobilities for zero field are calculated to be for H_2 6700 cm./sec. per volt/cm., and for He 10,840 cm./sec. per volt/cm. K. T. Compton's theory of electronic mobilities is shown to fit the observed variation of mobility with field strength, provided it be assumed that the fraction of its energy an electron loses at impact is in H_2 2·16 and in He 8·6 times what it would be were the collisions elastic. From the limiting values of the mobilities in zero field it is calculated that the mean free path of electrons in thermal equilibrium with the gas is for H_2 at 1 mm. pressure 0·0408 cm., and for He at 1 mm. pressure 0·066 cm. These values are approximately half the kinetic theory values. A. B. W.

2933. *Dissociation of the Nitrogen Molecule by Electronic Impact.* **V. Kondratjew.** (Zeits. f. Physik, 38. 4–5. pp. 346–352, 1926.)—In this paper it is shown experimentally that nitrogen molecules may be decomposed into excited atoms by means of electronic impacts, spectroscopic data being supplied for the appearance of atomic lines at a tension of 32 ± 2 volts. H. H. Ho.

2934. *Ionisation of Mercury-Vapour.* **G. W. Giddings** and **G. F. Rouse.** (Nat. Acad. Sci., Proc. 12. pp. 447–448, July, 1926.)—This is a continuation of previous work [see Abstract 2745 (1925)] in which it was found that mercury-vapour can be ionised by light of wave-length 2536 Å. The experimental arrangement was as previously described, except that a mirror was provided to reflect light to a photoelectric cell for intensity measurements. The value of n has been studied in the expression $C_0/C_1 = (I_0/I_1)^n$, where C_0 and C_1 are original and reduced ionisation currents and I_0 and I_1 the corresponding light intensities. As the vapour-pressure is increased with rise of temperature the value of n rises from 2 to 2·3. F. S.

2935. *Ionisation produced by Hydration of Sulphate of Quinine.* **Miss C. Chamié.** (J. de Physique et le Radium, 7. pp. 204–214, July, 1926.)—Le Bon and others have observed that the hydration (or dehydration) of quinine is accompanied by an ionisation of the air or other moist gas in which the phenomenon occurs, that ions of both signs are produced, but that the ionisation is stopped by the thinnest screen, and that the ionisation is accompanied by phosphorescence of the salt. The present investigation was based on studying the relation between the progressive hydration of the salt (as indicated by increase of weight with time) and the ionisation current. Although the curves were complex, because of the variable way in which moisture penetrated to the interior of the layer of quinine at different stages of the experiments, there was a clear parallelism between the ionisation of the air and the increase of weight of the salt by hydration. T. M. L.

2936. *Flow of Ions through a Small Orifice in a Charged Plate.* **L. Tonks, H. M. Mott-Smith, Jr.,** and **I. Langmuir** (Phys. Rev. 28. pp. 104–128, July, 1926.)—Measurements of ion and electron current densities and temperatures in a low-pressure arc may be made with a collector which is screened by a close parallel electrode pierced with uniform circular holes. The electrostatic potential distribution in the neighbourhood of a pierced electrode, pierced with either slit or hole, has been worked out. The volt-ampere characteristic for random electrons is exponential for the higher retarding voltages, and the exponent gives a temperature slightly too high. When the anode drop is known the current density of electrons can be calculated. The volt-ampere characteristic for positive ions is linear for small accelerating voltages. For small retarding voltages the characteristic is not a pure exponential. The characteristic gives anode drop, ion current density, "transverse" ion temperature and "longitudinal" ion temperature. The limitations and possible errors are discussed. AUTHORS.

2937. *Photo-Ionisation of a Gas by a Discharge in the Same Gas.* **F. L. Mohler.** (Phys. Rev. 28. pp. 46–56, July, 1926.)—Measurements were made in a tube containing two thermionic units electrically shielded from each other. The first served to give a discharge, the second detected ions produced by the radiation from the first by means of their effect on the space charge. Relatively little photo-ionisation is produced by arc radiation, while spark excitation and soft X-radiation give a strong effect. Curves of photo-effect *versus* discharge voltage show critical potentials which have been interpreted as follows: Ionisation of n_2 rare gas shell —Cs, 13·0; K, 19·0. Spark excitation—Cs, 18·5; K, 21·6; A, 32·2; Ne, 48·0. Double ionisation—Cs, 21·5; K, 31·8; A, 34·8; Ne, 54·9. Ionisation of n_1 rare gas shell—Cs, 39·0; K, 48·0; A, 39·6. The neon II spectrum is excited at 55 volts. It was shown that photoelectric emission from the electrodes was at least ten times as great as the photoelectric emission from the gas, while the current change produced by the space charge effect was more than 2400 times the ion current in argon and cæsium, the upper limit being quite indefinite [see Abstract 1097 (1926)]. AUTHOR.

2938. *Ion Rays.* **G. C. Schmidt.** (Ann. d. Physik, 80. 6. pp. 588–608, July 24, 1926.)—W. Gerlach has designated [see Abstract 1002 (1925)] those radiations consisting of electrically-charged particles sent out in straight lines, "ion rays." NaCl, KCl, CsCl, KBr, LiBr, NaI, KI, KFl, AgCl, AgBr, AgI send out only the ions at proportionately low temperatures (about 500°). At higher temperatures negative ions are also emitted, and finally at the highest temperatures the salt is directly dissociated into both kind of ions. LiCl emits approximately equally + *ve* and − *ve* ions. The emission of ions with the different salts is proportional to the number of ions in the corresponding melted portion. The mechanism of the emission is discussed. A. E. G.

2939. *Ionisation.* **K. K. Darrow.** (Bell System Techn. J. 5. pp. 463–492, July, 1926.)—A summary of modern views of ionisation and the experimental methods by which they have been established. A. Wh.

2940. *Electrons emitted from Cold Metal.* **F. Rother.** (Phys. Zeits. 27. pp. 471–472, July 15, 1926.)—After eliminating causes of error in discharges across small gaps *in vacuo*, there remains an effect distinctly traceable to the emission of electrons from the cold metal. A. D.

2941. *Anomalous Dispersion and Absorption of Electric Waves. Part III.* **S. Mizushima.** (Chem. Soc. Japan, Bull. 1. pp. 115–123, June, 1926.) —This paper presents a series of tables of results obtained with waves of wave-length 9·5 metres for monovalent alcohols. Previous papers [see Abstracts 1897 and 2682 (1926)] have given results for waves of 6·1 metres. The results for 9·5 metres show that propyl, isopropyl, isobutyl and amyl alcohols in general are similar in behaviour to glycerine. At higher temperatures there is only little absorption, and the values of ϵ (dielectric constant) are in good agreement with those measured for longer waves. As the temperature is gradually lowered both ε and K (electric conductivity) increase till each reaches a maximum. The maximum of K lies at the point where the temperature coefficient of ε is nearly a maximum. At still lower temperatures the values of K decrease and those of ε approach the square of the refractive indices for visible light. For ethyl alcohol the maximum of K was not reached, and for methyl alcohol neither maximum was reached, but it is probable that at lower temperatures they will behave like other alcohols. A. W.

2942. *Anomalous Dispersion and Absorption of Electric Waves. Part IV.* **S. Mizushima.** (Chem. Soc. Japan, Bull. 1. pp. 143–145, July, 1926).—This paper discusses the results of previous work [see Abstracts 1897 and 2682 (1926) and preceding Abstract] on anomalous dispersion of short wireless waves by various alcohols in relation to Debye's dipole theory. Debye's formulæ are used to calculate the values of the dielectric constant at various temperatures for ethyl, propyl, isobutyl and amyl alcohols. These are tabulated together with the values observed for radiation of wave-length 9·5 metres. The two sets of results are in good agreement, and it is concluded that Debye's theory holds very approximately for the monovalent alcohols. The discussion on glycerine will be given in a subsequent paper. A. W.

2943. *The Flattening of Steep Wave-fronts.* **F. Moeller.** (Archiv f. Elektrot. 16. pp. 289–293; Disc., 293, July 1, 1926.)—A theoretical discussion of the flattening of the wave-front of a "steep-fronted" progressive electric wave in a cable. A. B. W.

2944. *Oscillographic Study of Travelling Waves.* **D. Gábor.** (Archiv f. Elektrot. 16. pp. 296–302, July 1, 1926.)—The author describes a high-voltage (90,000-volt) kathode-ray oscillograph (cold kathode, soft vacuum type) and a method of traversing the spot across the photographic plate with a linear time scale. The instrument is applied to the study of travelling waves in high-tension electric cables, and specimen records are reproduced illustrating the reflection of these waves at the ends of (or discontinuities in) the cables. A capacity type "voltage-divider" (or potentiometer) is described for use in the investigation of very high-voltage waves. A. B. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2945. *Estimation of Dielectric Loss in Insulating Materials.* **G. Nyman.** (Zeits. f. Physik, 37. 12. pp. 907–910, 1926.)—The determination of loss in insulating materials is usually carried out by bridge or direct wattmeter methods. The latter have the advantage in speed and simplicity, while the former give somewhat greater accuracy. The present paper describes a wattmeter method suitable for high voltages and low current strengths, and includes the treatment of the theory, construction and availability of the special type of installation employed. H. H. Ho.

2946. *Dielectric Constants of Binary Mixtures.* **J. W. Williams** and **I. J. Krchma.** (Am. Chem. Soc., J. 48. pp. 1888–1896, July, 1926.)—An electrical resonance method, employing a Hartley circuit generating oscillations and a regenerative receiving circuit, is used for the determination of the dielectric constants of benzene, toluene, carbon tetrachloride, brombenzene and chlorbenzene, and of the following binary mixtures: benzene-toluene, benzene-carbon tetrachloride, chlorbenzene-brombenzene, at 25° C. over a range of concentrations. A new value is found for the dielectric constant of chlorbenzene. In a critical discussion of the results obtained it is shown that the changes taking place on solution are very intricate, but an attempt is made to explain them from a consideration of the observed values of the dielectric constants. A. B. C. L.

2947. *Surface of Metal and Semi-Conductor. Part I.* **G. Sadakiyo.** (Electrot. Laborat. Tôkyô, Japan, Researches, No. 166. [31 pp.], April, 1926.)

2948. *Photoelectric Conductivity.* **F. Kämpf.** (Zeits. f. Physik, 38. 1–2. pp. 104–115, 1926.)—The impact of red light on a layer of HgI_2 rendered conductive by the impact of blue-green light renders the layer more conductive at room-temperatures, less conductive at the temperature of liquid air. It is probable that this reducing effect is not entirely absent even at room-temperatures. There is a difference in the electronic properties for electrons stimulated by different wave-lengths; different potential distributions with equal current strengths; different relations for saturation current; different dependencies of the conductivity upon the stimulating intensity. At the temperature of liquid air the conductivity excited by blue-green light increases more rapidly than the intensity of the light. A. D.

2949. *Selenium Cell used with a Special Amplifier with Three-electrode Lamps.* **A. Rio.** (Rev. d'Optique, 5. pp. 268–279, June–July, 1926.)—A brief account of the history of the selenium cell and of its chief properties is given. A differential arrangement is described in which a condition of equilibrium is obtained by opposing equal electromotive forces to equal compensating resistances. A diagram is given to show the experimental arrangement. One or several three-electrode lamps are used for amplification, and the apparatus is named by the author a "selenometer." It is employed in two distinct ways. The first, it is claimed, has been useful in systems designed for protection against theft and fire. In the second the selenometer can be used for qualitative comparison of colours, the comparison of sources of light, and with certain modifications it can be employed as an ultra-sensitive detector of variations of luminous energy. Further work is in progress. A. E. G.

2950. *Low-Capacity Electrometer.* **J. Villey.** (Comptes Rendus, 182. pp. 1603–1605, June 28, 1926.)—In the electrometer described the four quadrants are replaced by four vertical wires symmetrically arranged about the suspension fibre. In one particular case the wires are 10 cm. long and 0·04 cm. diameter, being placed symmetrically on the surface of an imaginary cylinder 1 cm. in diameter. The needle is a thin rectangular silver leaf, 0·6 cm. broad and 5·5 cm. long. The needle and mirror are mounted on a stiff piece of copper wire whose lower extremity dips into an oil dashpot for the purpose of obtaining the necessary damping. The whole system in mounted in a tube whose external diameter is about 4 cm. F. S. B.

2951. *Capacity of a Two-Plate Electrometer.* **H. Hermann.** (Phys. Zeits. 27. pp. 523–524, Aug. 1, 1926.)—A re-statement and elucidation of certain equations for the capacity of an electrometer developed in a previous paper. [Abstract 553 (1923).] G. A. S.

2952. *An Interrupter for Use with the Mercury Thermoregulator.* **A. Leighton.** (Journ. Sci. Instruments, 3. pp. 377–379, Aug., 1926.)—A form of relay for use with thermoregulators is described which automatically interrupts the heating current if the electrical supply to the relay fails. AUTHOR.

2953. *Temperature Compensation of Precision Dynamometer Instruments.* **W. Phillips.** (Journ. Sci. Instruments, 3. pp. 374–377, Aug., 1926.)—Small residual errors are found in precision dynamometer instruments, partly due to the resistance temperature coefficient of the copper and aluminium windings, but more particularly owing to the self-heating effect of the current in the windings on the control springs. This article gives an account of the errors found in some instruments of this type and the method of compensating them. AUTHOR.

ALTERNATING CURRENTS AND MAGNETISM.

2954. *The Law of Conservation and Transformation of Vector Power for a System of Electric Currents in a Network.* **H. Nukiyama.** (Imp. Acad. Tôkyô, Proc. 2. pp. 208–211, May, 1926. In English.)—Gives expressions for the complex instantaneous power between a periodic e.m.f. and a periodic current and for the vector power, which is the time average of the complex instantaneous power; derives a symbolic form of Lagrange's equation and makes use of this in obtaining two equations which may be interpreted as formulating the law of conservation of vector power in electrical networks for periodic currents. Obtains an important integral condition for the phenomena of resistive, inductive and condensive frequency transformation in terms of the complex constant or the directional ellipse. H. N. A.

2955. *Transient Phenomena due to Sudden Changes of Circuit Constants.* **T. Hoashi.** (Inst. El. Eng. of Japan, J. No. 455. pp. 622–631, June, 1926.)—Heaviside's expansion theorem for the calculation of the transient phenomena in an electrical system due to sudden changes in the electromotive forces is also applicable to the calculation of the transient phenomena which occur when the circuit constants are changed suddenly. A few simple examples of the calculation for such cases are given in the present paper. AUTHOR.

2956. *Minimisation of Magnetic Leakage and of its Effects on the Magnetic Testing of Bars and Rods.* **E. Hughes.** (Phil. Mag. 2. pp. 162–176, July, 1926.)—A modified form of the Iliovici permeammeter is described in which the balance of magnetic potential is determined by a movable yoke. Experimental results are given showing that the magnetic leakage in a specimen under test varies considerably with the flux density and is dependent upon the disposition of the magnetising coils. Tests performed on mild steel and cobalt-chrome specimens indicate that the leakage is greatly affected by the permeability of the sample. The influence of the width of the search coil upon the accuracy of the magnetic testing is discussed mathematically. It is shown that a very large error in the determination of the magnetising force for a given flux density may be involved if the search coil is narrow, whereas with a search coil extending over the length of the bar under test the error is reduced to a small value. Curves are given showing the percentage errors involved with the extended search-coil for different leakages and different flux densities, the flux density being expressed as a fraction of the saturation density. W. V. M.

2957. *Suppression of a Single Frequency by Resonant Circuits and Regeneration.* **J. A. Stratton.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 95–105, July, 1926.)—Discusses the application of regeneration to the *complete* suppression of a single frequency without at the same time greatly reducing the amplitude of the frequency which it is desired to pass. Both tuned grid and tuned plate circuits are discussed, and a numerical example is given showing the sizes of coils required to obtain the same resonance characteristics, with and without regeneration. Ten diagrams are given. W. H. Ge.

2958. *Change of Temperature and Magnetic Induction of Steel in Tension and Compression Tests.* **Y. Kidani** and **R. Sasaki.** (Imp. Acad. Tôkyô, Proc. 2. pp. 212–213, May, 1926. In English.)—Gives curves showing the relation between load, extension, change in magnetic flux and temperature changes due to evolution or absorption of heat during a tension test of steel; similar measurements were made in compression tests. A point of minimum temperature was found in the tension tests, and a noticeable point where the temperature slope altered in the compression tests during the transition from the elastic to the plastic state. The relations between the curves at the yield-point have been studied, and the author is of the opinion that fresh light may be thrown on the nature of the elastic limit by these new methods. H. N. A.

2959. *Hysteresis and Reversibility.* **K. Uller.** (Zeits. f. Physik, 38. 1–2. pp. 72–93, 1926.)—It is shown that hysteresis is in general a problem of two parameters, and that reversibility and freedom from hysteresis are not to be indentified as the same phenomenon. This thesis is discussed at considerable length. W. V. M.

2960. *Structure of the Atomic Magnet. Deformation of the Multiplet by the Field. The Triplet in Iron.* **R. Forrer.** (Comptes Rendus, 182. pp. 1530–1532, June 21, 1926.)—Taking I_s for iron as 1706, the value of I_r is given by $\frac{1706\sqrt{3}}{3} = 986$ for a rectangular triplet. The largest value of I_r obtained by experiment is 982. Hence the atomic magnet of iron is very probably a rectangular triplet. This view offers a simple explanation of the almost right-angled cycle given by electrolytic iron deposited in a magnetic field. The three elements are inclined at equal angles to the field, and at a certain unique field value are all reversed. It is further considered that the approach of the components of the magnetic multiplet is an intra-atomic reversible phenomenon. [See Abstract 2704 (1926).] G. E. A.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2961. *Adsorption of Organic Acids by Two Activated Charcoals of Different Origin.* **P. Surun.** (Comptes Rendus, 182. pp. 1544–1546, June 21, 1926.)—The adsorption of acetic, oxalic, tartaric and citric acids in aqueous solutions of concentrations ranging from N/10 to N/100 by charcoals activated by $ZnCl_2$ and by heat respectively is determined. The results are perfectly consistent with Freundlich's rule, but are in opposition to the conclusions of Fromageot and Wurmser, showing, in fact, that the molecular fraction of the organic acids adsorbed is generally less with increased number of COOH groups, independently of the concentration of the solution. A. B. C. L.

2962. *Interpretation of Adsorption Isotherms and Isosteres.* **A. S. Coolidge.** (Am. Chem. Soc., J. 48. pp. 1795–1814, July, 1926.)—The "capillary condensation" theory is found inadequate. In particular it predicts temperature coefficients much greater than those observed. It must therefore be supposed that all adsorbed molecules are directly attracted by the adsorbent. The conditions are discussed under which the action of forces which are continuous functions of the distance can nevertheless give rise to potentials which are discontinuous functions of the volume occupied by the adsorbed gas, thus explaining breaks observed in the isotherms at saturation which suggest the appearance of a new phase. The application of the equation of Clausius and Clapeyron to give the relation between heats of adsorption and slopes of the isosteres is found to be valid within a few per cent., and an explanation of the residual discrepancy is offered. It is concluded that for unsaturated systems the earlier conception of the heat of adsorption as a heat of compression is erroneous, but that the heat is to be considered as representing the work done by the attraction of the adsorbent together with the ordinary latent heat of condensation. The evidence for the existence of a high pressure due to adsorption is found incapable of being reconciled with the idea that the adsorbed liquid obeys its ordinary equation of state. It is concluded that the liquid must be thought of as fundamentally altered in state as with ordinary solutions. [See Abstract 1942 (1924).]
J. N. P.

2963. *Adsorption of Gases by Platinum Black.* **A. F. Benton.** (Am. Chem. Soc., J. 48. pp. 1850–1861, July, 1926.)—At 25° and under 1 atmosphere pressure hydrogen and carbon monoxide are adsorbed to equal extents by one and the same specimen of platinum black, but the adsorption of oxygen is only about one-half as great. Comparison of the results obtained with those of other investigators leads to the conclusion that, if the experiments were repeated at somewhat higher temperatures, the adsorption of carbon monoxide and hydrogen would remain unchanged whereas that of oxygen would increase. It may be questionable whether the oxygen adsorption would finally equal that of the other two gases, but the results for the latter are clearly in harmony with the view that they form on platinum black "saturated" unimolecular layers. T. H. P.

2964. *Absorption of Iodine by Various Substances.* **A. Lottermoser** and **L. Herrmann.** (Zeits. phys. Chem. 122. pp. 1–27, July 20, 1926.)—The absorption of iodine by basic lanthanum acetate from solutions containing also potassium iodide proceeds in accord with adsorption isotherms. The adsorption diminishes as the age of the substrate increases, but absorption of iodine prevents further ageing, although a sudden decrease in the surface may occur by electrolytic action at the moment of the absorption. The potassium iodide is taken up to only a slight extent. The absorption of iodine by gliadin follows a similar course, but is increased as a result of swelling; the process is, however, reversible. The results obtained with cholic acid and with calcium oxide and hydroxide are described. T. H. P.

2965. *Adsorption of Water on a Plane Fused Quartz Surface.* **S. Lenher.** (Chem. Soc., J. pp. 1785–1792, July, 1926.)—The properties of the thick film of water which is known to be held on a glass surface are investigated by measurements of the change of pressure with temperature of the vapour at constant volume given by varying amounts of water, the internal surface of the constant-volume vessel, consisting of a quartz tube, being used as the adsorbing surface. The decrease of free energy $-\Delta F$ of water between the liquid state and that in an adsorbed film is calculated from the usual equation $-\Delta F = RT \log (p/p_1)$, where p is the pressure of water-vapour in equilibrium with liquid water at T° and p_1 is the equilibrium pressure of the adsorbed film at T°. It is found that the adsorption does not become of relatively great magnitude until the saturation pressure is nearly reached. It is concluded that the first effect, starting with a perfectly clean surface and low values of the pressure, is to build up a primary unimolecular gas layer as the pressure of the vapour increases. At a certain value of the pressure the unimolecular gas layer begins to "liquefy" and increases without increase of p. When this process is completed, the adsorption increases with renewed increase of p, and we now have the formation of the film of multimolecular thickness. The isosteric heats of adsorption are calculated from the change of adsorption pressure with temperature and, on silica and platinum, are estimated to be of the same order of magnitude as the corresponding heats of condensation to liquid water in bulk. These values do not apply to the region of adsorption of the unimolecular layer. It is highly probable from the great stability of the primary film that the heat of adsorption for this first layer is much greater than the latent heat of condensation. J. N. P.

2966. *Origin of the Charge on Colloidal Particles.* **H. B. Oakley.** (J. Phys. Chem. 30. pp. 902–916, July, 1926.)—The theory of surface ionisation is developed so as to furnish an explanation of the electrical charges occurring in colloidal particles. Combination of the equation for the Donnan ionic equilibrium with that expressing the dissociation of weak acids or bases leads to an extension of Loeb's views ("Proteins and the Theory of Colloidal Behaviour"), which supplies a rational explanation of the general behaviour of colloids towards acids, bases and salts. The results of Bradfield's work on the behaviour of suspensions of clay [Abstract 1679 (1923)] agree closely with those predicted by the above theory, which also permits of rational deductions being made as to the nature of the electrical double layer of colloids. The present method of measuring the charge on colloids is adversely criticised, and an alternative is suggested. T. H. P.

2967. *Mechanism of Emulsification.* **A. J. Stamm** and **E. O. Kraemer.** (J. Phys. Chem. 30. pp. 992–1000, July, 1926.)—A survey of recent studies of emulsions demonstrates that much of the original evidence for the "oriented wedge" theory of emulsions has not been confirmed. It is suggested that insufficient attention has been paid to the mechanism of emulsion formation. Emulsification by shaking, mixing, etc., is regarded as consisting of two stages: (1) pulverisation of both phases into lamellæ and drops, and (2) coagulation of the drops of one or both phases. The degree of dispersion and the phase relations of an emulsion are the net results of these two opposing processes. An emulsifying agent protects, to a greater or less extent, the drops of one phase already formed in the pulverising stage from reuniting, while permitting the coagulation of the drops of the other phase to form the dispersion medium. The stabilising effect is probably due to the formation of a film at the interface, but the character of this film is incompletely understood. Examples are given demonstrating the complexity of the mechanism of emulsification.
A. B. C. L.

2968. *Extension of the Debye-Hückel Theory of Strong Electrolytes to Concentrated Solutions.* **T. H. Gronwall** and **V. K. LaMer.** (Science, 64. p. 122, July 30, 1926.)—In deriving an expression for the electrostatic free energy of a solution, the dielectric constant is no longer assumed to be independent of the concentration. Methods are developed for calculating from experimental data (freezing-point and vapour-pressure lowering, electromotive force, solubility) not only the free energy term referred to, but also the ionic radius and the change in the dielectric constant with changing concentration. It is found that the ionic radius and the dielectric constant vary rapidly with the temperature. Moreover, at any fixed temperature, but with increasing concentration, the dielectric constant begins by decreasing much more (from 50 to 100 times) rapidly than Hückel's expression indicates. It soon reaches a minimum and starts to increase more slowly, until in very concentrated solutions it is considerably larger than in pure water. It is also found that certain salts—for instance, potassium nitrate—do not conform to the theory, the probable explanation being that in addition to its electric charge the NO_3 ion also carries an electric dipole moment. [See Abstracts 1957 (1924), 1267 (1925).] J. N. P.

2969. *Transition Points of Salt Hydrates in Non-Aqueous Solvents.* **W. W. Lucasse** and **J. McA. Harris, Jr.** (J. Phys. Chem. 30. pp. 930–938, July, 1926.)—The results of this investigation indicate that, even though dissolved, a measurable change takes place at the transition points of salt hydrates. Values of the transition points are given for certain salts from a study of the resistance-temperature curves of their solutions in alcohol. The results were obtained by calculating the intersection of the two curves resulting from the difference of potential in the slopes of the curves below and above the transition point. A. B. W.

2970. *Sedementation Hysteresis.* **B. Iliin.** (Zeits. phys. Chem. 122. pp. 137–148, July 20, 1926.)—It was found that the precipitation of colloidal solutions took place with different velocities, depending upon whether the colloidal solution was mixed with the precipitant and immediately centrifuged or whether the mixture was allowed to stand for a long or short time after preparation. In some cases the velocity was increased, in others it was found to decrease, and after a considerable interval of time the velocity reached a definite value. The mixtures investigated were starch and copper ammonium hydroxide and starch and sodium hydrate, blood albumin and alcohol; the concentrations ranged from 0·5 to 1·0 %, and the temperature from 18° to 20° C.

F. J. B.

2971. *The A_2 Line in the Equilibrium Diagram of the Iron-Carbon System.* **K. Honda.** (Tohoku Univ., Sci. Reports, 15. pp. 247–250, May, 1926. In English. Report No. 122 from the Research Inst. for Iron, Steel and other Metals.)—Discusses the nature of this line, and concludes that for low carbon concentration there are really two horizontal lines about 20° apart, one due to ferrite and the other to austenite. The actual observations cannot be expected to bring this out. For low carbon content the effect of the ferrite is greatest and for high carbon content that of the austenite; the result is that the combined A_2 curve slopes downwards towards the lower horizontal line. These lines do not indicate a change of phase and are therefore shown in the diagram as dotted lines. The author considers that *α*-iron has a body-centred cubic lattice and *γ*-iron a face-centred cubic lattice. Magnetism is an atomic property and may vary independently of the lattice arrangement.

H. N. A.

2972. *Hardness of Different Structures in Steel.* **K. Tamaru.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers No. 67. pp. 25–44, July, 1926. In English.)—The hardness of constituents of carbon steels was measured at laboratory temperatures by an indentation method. The figures in brackets after each constituent are the Brinell hardness: austenite (155), cementite (640, increased to 820 when subjected to internal strain), martensite (720), sorbite (270), troostite (400). The relative amounts of carbon and manganese required to give an austenite structure on water-quenching have been determined, and the hardness of such austenite is 182. Increasing the temperature of a steel of austenite structure (Mn, 9·63 %; C, 0·93 %) decreases the hardness to a minimum at 300°, from which point it increases to a maximum at 600°. In an austenite nickel steel (Ni, 26·73 %; C, 0·42 %) there is a minimum hardness at 450° and a maximum at 630°. It is considered that the maxima at about 600° correspond with the "blue shortness" of steel. The hardness of carbon steels, water-quenched from 900°, increases with increasing carbon content up to 0·8 % and then diminishes. The change of hardness with tempering temperature was determined in a water-quenched 0·89 % carbon steel.

L. M. C.

2973. *Some Properties of the Alloys Gold, Silver and Copper.* **L. Sterner-Rainer.** (Zeits. f. Metallkunde, 18. pp. 143–148, May, 1926.)—The constitutional diagram of the above ternary system has been found from observations on the cooling of forty-five alloys. The following mechanical properties have also been found: Brinell hardness, limit of proportionality, breaking load, and elongation. They were determined with the alloys in three states, *viz.* annealed, quenched and cold-rolled. The results are given in a series of tables. It should be noted that no one of the above properties by itself can be used as a reliable guide to the brittleness or forgeability of the alloys. A. A. D.

2974. *Ionisation of Gases as a Type of Chemical Activation.* **S. C. Lind.** (Science, 64. pp. 1–6, July 2, 1926. Paper read before the Am. Chem. Soc., March, 1926.)—The chemical activity of the ions is expressed by the term M/N or μ, where M is the number of molecules reacting and N the number of ion pairs formed in unit time. The proportionality factor μ varies for different reactions from about 0·5 up to about 20 with a marked peak in the region of 2 to 6. The following general velocity equation is derived from a reaction accompanied by a change of the number of molecules :—

$$\frac{k\mu}{\lambda} = \frac{\log \frac{P}{P_0}}{E_0(e^{-\lambda t} - 1)},$$

where λ is the decay constant of radon, P is the gas-pressure at time t and P_0 the initial pressure. E_0 is the initial quantity of radon, k is a constant which changes with the shape and volume of the container. In the formation of ozone from oxygen the value of M/N is approximately unity. The results are given in detail of measurements made on the synthesis of water by α-rays of radon. The average value of M/N is found to be 3·85 and is independent of the ratio H_2/O_2, which demonstrates, as with other reactions, that the ions of either components are equally efficient in producing chemical action, and the reaction mechanism and ionic efficiency are independent of the reaction mixture. A probable mechanism which is suggested assumes the formation of a stoichiometric cluster of the composition $(H_2 . O_2 . H_2)^+$ to be formed around a positive ion either O_2^+ or H_2^+ and a similar cluster $(H_2 . O_2^- . H_2)$ to be formed around a negative O_2^- ion. The positive and negative clusters finally recombine to give $4H_2O$. Similar mechanisms are deduced for the oxidation of CO and CH_4. The positive cluster is in each of these instances limited to the value of 2. With unsaturated compounds of carbon the clusters are larger. J. N. P.

2975. *Active Nitrogen. Part I. Its Nature and Heat of Formation.* **E. J. B. Willey** and **E. K. Rideal.** (Chem. Soc., J. pp. 1804–1812, July, 1926.)—Active nitrogen is prepared by causing the gas which has been freed from oxygen to traverse, at a pressure of 10 mm., a tube through which a powerful electric discharge is passed, and is led into a calorimeter in which either nitric oxide or air are also admitted. With nitric oxide the reactions brought about are expressed as follows: N_2 (active) $+ 2NO \longrightarrow N_2 + O_2 + E + 43{,}120$ cals. $2NO + O_2 \longrightarrow 2NO_2$, where E is the heat of activation of nitrogen and 43,120 is the heat of decomposition of NO. The gases are led from the calorimeter through a U-tube cooled in liquid air, where the NO_2 is slowly formed, condensed and afterwards estimated. A mean value of 43,800 cal./gm. mol. is obtained for the heat of activation of nitrogen. In a second method deactivation of the nitrogen is brought about in the calorimeter by the catalytic action of the air, and the heat value by this method is estimated to be 41,200 cal./gm. mol., the mean of the two values being 42,500 cal./gm. mol., corresponding to an energy level of about 2 volts. It is concluded that active nitrogen is nitrogen in a metastable molecular form. The value is obtained on the assumption that active nitrogen can activate only one molecule of NO during its reversion to the normal form. The view that the energy content of active nitrogen is more than 40,000 but less than 90,000 cal./gm. mol. is supported by a consideration of the minimum chemical critical energy increments or energies of activation of substances which extinguish the fluorescence of active nitrogen.

J. N. P.

2976. *Dissociation of the Water-Vapour Molecule.* **H. Senftleben** and **I. Rehren.** (Zeits. f. Physik, 37. 7–8. pp. 529–538, 1926.)—When a mixture of water-vapour molecules and mercury molecules is radiated upon by the resonance lines of Hg there is, under shocks of the second kind, a displacement of the dissociation equilibrium of the water-vapour molecules ; the proportion dissociated is increased. The same new equilibrium is reached when a mixture of water-vapour and oxygen molecules is subjected to shocks of the second kind. The products are all condensed (except pure hydrogen) by liquid air. From thermochemical data it follows that the dissociation is $H_2O + U = H + OH$, in which OH acts as a halogen.

A. D.

2977. *The Electronic Affinity of Oxygen.* **H. Senftleben.** (Zeits. f. Physik, 37. 7–8. pp. 539–547, 1926.)—From the data of the preceding investigation the energy is calculated which is required for the break-up of combinations of alkali hydroxides and of water, both into atoms and into ions. Grimm's law for the displacement for elements at period-ends through reception of H-atoms is confirmed [see Abstract 35 (1926)], and Hund's results [see Abstract 1558 (1925)] are also confirmed. From these the electronic affinity of the oxygen atom for the two electrons taken up can be computed. The work of separating a first electron is negative ; that of separating a second is positive ; the aggregate electronic affinity is null or feebly negative according to the value of the dissociation heat of the oxygen. Similar results are obtained with the H_2S molecule.

A. D.

2978. *Phenomenon of Valency.* **Rajendralal De.** (Sci. Assoc. Maharajah's Coll., Vizianagaram, J. 2–4. pp. 114–119, May, 1926.)—It is suggested that polar valency be termed electrostatic bond, and non-polar valency simply valency. The ionisation of substances yielding ion radicals is assumed to be caused by transference of electrons from one radical to another. In such cases it may be supposed that the group displacement law of Fajans and Soddy relating to the expulsion of a β-particle from a radioactive element is applicable, so that the valency in the radical from which the transference of the electrons takes place increases by one for each electron transferred ; also the valency in the radical receiving the electrons should decrease by unity for each electron received. These views are applied to furnish explanations of the behaviour of certain elements. In the formation of ammonium chloride the nitrogen atom parts with one electron, and, having thus gained an additional valency bond, unites with the hydrogen atom of the hydrogen chloride, the electron thus separated being taken up by the chlorine atom. Accordingly, the nitrogen atom in ammonium chloride is considered to have four valencies, the ammonium radical being attached to the chlorine radical simply by an electrostatic bond. T. H. P.

2979. *Types of Chemical Combination.* **H. Lux.** (Zeits. phys. Chem. 121. pp. 456–462, June 30, 1926.)—When a molecule is formed from two atoms, three forms of distribution of the linking electrons are possible: (1) A valency electron may pass entirely over to the other atom, so that electrostatic attraction results: polar linking. (2) One or several electrons of the one atom become common to the two atoms, so that electric polarity is conferred on the molecule: semi-polar linking. (3) The linking electrons are derived, one-half from the one and the second half from the other atom, the electric polarity being thus compensated. The number of the linking electrons with this non-polar linking is necessarily even. It is shown that for large and important groups of compounds neither the polar nor the non-polar conception furnishes a satisfactory interpretation of the properties, this being afforded only by assuming the semi-polar linking. T. H. P.

2980. *Polarisation of Hydrogen Atoms in Organic Compounds.* **A. E. van Arkel** and **J. H. de Boer.** (Zeits. phys. Chem. 122. pp. 101–112, July 20, 1926.)—In $(BH_3)_2$, CH_4, methane or ethane halides, hydrogen appears to play the part of a halogen, as in LiH, etc. Comparison of an array of physical constants in homologous compounds confirms this view. The mode of combination seems to be heteropolar, not homopolar.

A. D.

2981. *Significance of the Dielectric Polarisation of Aqueous Solutions.* **L. Ebert.** (Zeits. phys. Chem. 122. pp. 28–38, July 13, 1926.)—With the help of the Lorenz and Lorentz mixture formula, a scheme is developed for the analysis of the experimental data referring to the dielectric polarisation of aqueous solutions. For the reciprocal action between the dissolved molecules and the water dipole a relation is derived which, for simple salts, has an absolute magnitude and a variability with the concentration such as would be expected. For solutions of non-electrolytes it is not possible to draw any secure conclusions concerning the magnitude of the orientation polarisation of the solute from the sense in which the dielectric constant changes during solution. In the cases considered only probable minimum values for this magnitude may be deduced from the scheme of analysis. It is found, for instance, that cane sugar, although it depresses the dielectric constant of water, must possess an appreciable dipole moment. In very dilute solutions of molecules of abnormally large moments more accurate estimates are possible. [See Abstract 730 (1925).] T. H. P.

2982. *Order of Removal of Manganese, Chromium, Iron, Cobalt and Nickel from Amalgams.* **A. S. Russell, D. C. Evans** and **S. W. Rowell.** (Chem. Soc., J. pp. 1872–1881, July, 1926.)—The order of removal of zinc, cadmium, thallium, tin, lead, copper and bismuth from mercury by oxidising agents is that to be expected from the positions of these metals in the normal potential series, whereas that of manganese, chromium, iron, cobalt and nickel is not according to expectation [Abstract 402 (1926)]. The order in mercury is zinc, cadmium, manganese, thallium, tin, lead, copper, chromium, iron, bismuth, cobalt, mercury and nickel. The absolute positions of manganese, chromium, iron, cobalt, and nickel are displaced towards the noble elements, but their relative order remains unaltered. The abnormal behaviour of these elements is ascribed to a type of passivity, an electronic theory of which is put forward. The active state of these metals is ascribed to the existence of two electrons in the four-quantum orbit of the atom, and the passive state to one electron in this orbit. Reducing properties of amalgams of manganese, tin and iron are described. T. H. P.

2983. *Positions of Tungsten and Molybdenum in the Normal Potential Series.* **A. S. Russell** and **S. W. Rowell.** (Chem. Soc., J. pp. 1881–1892, July, 1926.)—When acid solutions of tungsten and molybdenum salts are shaken with amalgams of different metals, the ions are mostly reduced only to the tervalent state, but a small part is reduced to the metallic state and may be identified by its catalytic action on the change $2H \longrightarrow H_2$; a delicate reaction for the identification of tungsten in solution is thus furnished. The catalytic actions of tungsten, molybdenum and platinum on the reaction $2H \longrightarrow H_2$ initiated by zinc amalgam in contact with sulphuric acid are similar and greater than those of palladium, chromium, manganese, cobalt and iron. The positions of tungsten and molybdenum in the normal potential series are approximately that of mercury. At room-temperature chromium, manganese, iron, cobalt, molybdenum and tungsten pass into true solution in mercury to a small extent only, the solubility varying for the first five metals from 10^{-5} to 5×10^{-5} grammes per gramme of mercury. The possibility of the existence of a more active form of tungsten and molybdenum is discussed. T. H. P.

2984. *Moving-Boundary Method of Determining Transference Numbers. Part V. A Constant-Current Apparatus.* **D. A. MacInnes, I. A. Cowperthwaite** and **K. C. Blanchard.** (Am. Chem. Soc., J. 48. pp. 1909–1912, July, 1926.)—A description is given of an apparatus involving a photoelectric relay system which maintains a current constant to within 0·02 to 0·03 % through a moving-boundary apparatus with a resistance steadily increasing during a determination. [See Abstracts 1773, 1774 (1925).] T. H. P.

2985. *Electrometric Study of the Allotropic Forms of Mercuric Sulphide.* **M. Bourgeaud.** (Comptes Rendus, 182. pp. 1619–1621, June 28, 1926.)—The red and black sulphides of Hg are studied in cells of the type Hg⁝Solid Hg_2Cl_2, Saturated KCl⁝Saturated KCl in agar-agar⁝$Am_2S \times HgS$⁝Hg. With the red sulphide and a molecular solution of Am_2S, the e.m.f. at 18° C. is 0·7934 volts, the cell being reversible. With the black sulphide the initial e.m.f. is 0·6098, growing, however, with gradual transformation to the red variety, to its appropriate value. The results obtained cannot be explained by means of Nernst's theory. A mechanism to account for the change from the black to the red variety is suggested. A. B. C. L.

2986. *Electrokinetic Behaviour and Electrode Potential.* **F. L. Usher.** (J. Phys. Chem. 30. pp. 954–963, July, 1926.)—The results obtained on measuring the contact potential and the electrocapillary behaviour of mercury in solutions of different uni-univalent electrolytes fail to indicate any direct connection between electrode potential and electrokinetic behaviour in the case of this metal. Comparison of the potentials of mercury in solutions of chlorides with and without addition of hydrazine show that, whenever the metal is brought into contact with such solutions, chemical action results in the production of mercurous ions which are present at the interface in nearly the same concentration as if the solutions had previously been saturated with calomel. Electro-osmotic experiments on the influence of potassium chloride on the surface charge of a diaphragm point to an initial adsorption of that ion which enhances the original charge, this effect being greatly reduced when a strongly adsorbed ion bearing the same charge as the surface is present. T. H. P.

2987. *Potential of the Iron Electrode.* **W. H. Hampton.** (J. Phys. Chem. 30. pp. 980–991, July, 1926.)—Measurements are made of the potential of several varieties of Fe in the cell $Fe/FeCl_2$(aq.), HgCl/Hg containing no liquid junction. An iron amalgam prepared by electrolysis of a solution of $FeSO_4$, using a mercury kathode, gives 0·809 volt as the best equilibrium value in 0·1M$FeCl_2$. Finely divided Fe prepared by reduction of Fe_2O_3 gives a value 0·8088 volt. Potentials of annealed Fe in water solutions are much lower than those obtained with the other varieties. On measuring the potential between finely divided Fe and the annealed form in a water-free solution consisting of $FeCl_2$ in a fused eutetic mixture of LiCl and KCl little difference is found between the activity of each. The difference in water solutions is attributed to passivity of compact Fe in contact with water. From the measurements made, the most probable value of the normal electrode potentials of Fe is estimated at 0·4413 volt. Measurements made on the equilibrium $Fe + 2TlCl = Fe^{++} + 2Cl^{-} + 2Tl$ substantiate this conclusion. A. B. C. L.

2988. *Dissociation of Lithium Chloride and Sodium Bromide in Ethyl Alcohol.* **C. Drucker** and **R. Schingnitz.** (Zeits. phys. Chem. 122. pp. 149–169, July 20, 1926.)—E.m.f. measurements are made of the following chains in an ethyl alcohol solvent:—

$$Ag/AgCl\,.\,\underset{I}{LiCl}/\underset{II}{LiCl}\,.\,AgCl/Ag\,; \qquad Li_xHg/LiCl\,.\,AgCl/Ag\,;$$

$$Ag/AgBr\,.\,\underset{I}{NaBr}/\underset{II}{NaBr}\,.\,AgBr/Ag\,; \qquad Na_xHg/NaBr\,.\,AgBr/Ag.$$

Measurements are made of the apparent molecular weights by raising the boiling-point at 35° C., the pressure being about 100 mm., and transition numbers are determined by the migration method and from the e.m.f. of concentration cells. Divergencies are found in the degree of dissociation as estimated by conductivity, osmotic effects, and e.m.f.'s. The highest dissociation values are given by the boiling-point method and the lowest by the e.m.f. method. The results indicate that marked solvation occurs even in dilute solutions. The limiting concentration values for the ionic mobilities at 25° C. are determined for the ions $H^{\cdot}$, $Li^{\cdot}$, $Na^{\cdot}$, Cl', and Br'. By an e.m.f. determination in an alcohol solution of $NaClO_4$ the solubility product of AgCl is estimated to be 4×10^{-18}. The introduction of this value in the chain $^{-}\mathrm{Li}/\underset{\text{in water}}{\mathrm{LiCl}}\,.\,\mathrm{AgCl/Ag/AgCl}\,.\,\underset{\text{in alcohol}}{\mathrm{LiCl}}/\mathrm{Li}^{+}$ gives a large difference from the measured value. A similar departure is also obtained with the cell H_2/HCl in place of Li/LiCl. It is inferred from this that a higher degree of solvation occurs with alcohol than with water. J. N. P.

2989. *Passage of Current in Solid Cells.* **P. Vaillant.** (Comptes Rendus, 182. pp. 1335–1337, May 31, 1926.)—The author remarks about peculiar polarisation effects which appear when currents are passed between electrodes in solid compounds—NaCl, KBr, $BaCl_2$, Na_2SO_4. A. B. W.

2990. *Effect of Superposed Alternating Current on the Polarisable Primary Cell Zinc-Sulphuric Acid-Carbon. Part II. High-Frequency Current.* **A. J. Allmand** and **H. C. Cocks.** (Roy. Soc., Proc. 112. pp. 252–258, Aug. 3, 1926.)—High-frequency currents have a very considerable depolarising action on an anode of amalgamated zinc in a solution containing free acid, this effect, as suggested by Brown [Abstract 1641 (1914)], being the cause of the increased current output in the zinc/sulphuric acid/carbon cell. Both electrodes contribute to the polarisation, the carbon to a much greater extent than the zinc. Whereas, however, low-frequency currents [Abstract 1262 (1925)] affect the zinc electrode to only a small degree, whilst materially decreasing the polarisation at the carbon, high-frequency currents are without any effect whatever on the carbon and profoundly influence the zinc electrode. The depolarising action of the low-frequency currents on the carbon electrode may be attributed to the partial destruction of the hydrogen charge during the anodic pulse, a reaction which is by no means instantaneous and therefore the more marked the lower the frequency. The effects at the zinc electrode are less easy to analyse [see next Abstract], but they do not appear to be connected with the disruption of a visible film of gas by means of a rapidly alternating electrical stress. There is no perceptible change in appearance of the gas-covered zinc anodes when the current is applied, and no change in appearance or decrease in overvoltage at the carbon kathode under the same circumstances. Further, when the zinc is immersed in a zinc sulphate solution under conditions which render possible diffusion of acid from the kathode, although both polarisation of the anode and its removal by the high-frequency current are observed, no visible bubbles of gas appear on the zinc. T. H. P.

2991. *Polarisation of Zinc Electrodes in Neutral and Acid Solutions of Zinc Salts by Direct and Alternating Currents. Part I.* **A. J. Allmand** and **H. C. Cocks.** (Roy. Soc., Proc. 112. pp. 259–279, Aug. 3, 1926.)—Certain of the factors affecting the phenomena of the polarisation of zinc electrodes [see preceding Abstract] are investigated. Results are given of measurements at room-temperature of potentials of zinc sulphate solutions with amalgamated zinc electrodes in the absence and presence of free sulphuric acid and with unamalgamated electrodes in neutral solution. Alternating currents, both alone and superposed on direct currents, were used and, in a few cases, direct currents alone; the frequencies varied between 50 and 11,000. The polarisation phenomena observed appear to be due to retardations in the actual electrode process, these retardations being closely connected with charges of atomic oxygen and hydrogen in the electrode surface layers. The results obtained are discussed in detail, and various assumptions are made in order to account for them. T. H. P.

2992. *Carbon Tetrafluoride.* **P. Lebeau** and **A. Damiens.** (Comptes Rendus, 182. pp. 1340–1342, May 31, 1926.)—In the preparation of glucinium by the electrolysis of a mixture of glucinium fluoride and an alkaline fluoride, the authors observed the formation at the anode of a gas containing fluorine and carbon. In the present paper the composition of this gas is determined and the investigation extended to the compounds resulting from the direct action of fluorine on the various kinds of carbon. In this manner a compound CF_4 has been prepared and its properties investigated. The authors regard this as a newly discovered chemical compound. A. B. W.

2993. *Electrolysis of Sodium Chromate with a Mercury Kathode.* **I. Stacherbakoff** and **O. Essin.** (Zeits. Elektrochem. 32. pp. 396–399, Aug., 1926.)—Solutions of sodium chromate are electrolysed in a vessel with a platinum anode and a kathode of mercury enclosed in a porous pot [see Abstract 2634 (1925)]. The potassium ions combine with the mercury to form an amalgam and the chromate ion is transformed to bichromate. As with the hydrogen overvoltage, the current yield of the process is increased by an increase in the current density, a lowering of temperature and by increasing the salt concentration of the electrolyte. The complete conversion of the chromate into bichromate corresponds with the removal of one-half of the potassium ions, and beyond this stage polychromates are formed. Curves giving the conductivity of the electrolyte plotted against the percentage of the kations removed by electrolysis show that the conductivity increases with the proportion of the potassium ions which are removed, and the curves show a marked inflexion upwards at an electrolyte composition corresponding to $Na_2Cr_4O_{13}$. It is concluded that beyond this point no further polymers are formed, and the conductivity approaches the value for pure chromic acid. J. N. P.

2994. *Electrolytic Separation of Chromium from Aqueous Chromic Acid Solutions.* **E. Müller.** (Zeits. Elektrochem. 32. pp. 399–413, Aug., 1926.)—The reduction of the hexavalent to the trivalent chromium ion begins at an electrode potential of from + 0·7 to + 1·9 volt according to the nature of the kathode. On making the potential more negative, the formation of a diaphragm of chromium oxides occurs at about + 0·3 volt, when the reduction of the hexavalent chromium ion is arrested on account of the impervious nature of the diaphragm to these ions. H ions, however, pass through and are liberated on the kathode at a potential corresponding to the overvoltage value of the kathode. At the higher potential of about − 0·7 volt, metallic chromium is deposited on the kathode. It is concluded that this occurs through a reduction of the oxide of the diaphragm when the separation potential for the low concentration of Cr ions is reached and the diaphragm becomes conducting and allows the passage of the chromic acid, which is reduced directly to metal. It is concluded that with potentials more positive than + 0·3 volt, diaphragms are formed by chemical action of the chromic acid when the kathodes are of platinum or other metal, but not when of carbon, with which element electrolytic reduction of the chromic acid to the chromium ion occurs at a more positive potential. An investigation is made of the characteristic features of the current-potential curves of the periodic oscillations described by Liebreich and of the influence of certain anions such as SO_4'', which, when added to the chromic acid, lead to a charging of the diaphragm. The influence of these additions in electroplating is discussed. [See also Abstract 1640 (1921).] J. N. P.

2995. *Electrodeposition of RaD and RaE.* **J. P. McHutchison.** (J. Phys. Chem. 30. pp. 925–929, July, 1926.)—The work of Hevesy on the deposition of radioactive isotopes of bismuth and of lead on metals when the metals are dipped into solutions containing their own ions has been extended by the author to the case of metals dipping into pure water. The isotopes of bismuth and of lead used were RaE and RaD respectively. It has been found that these isotopes are deposited on metals irrespective of whether the latter are more electropositive or electronegative than bismuth or lead. It has also been found that the ratio of RaD to RaE deposited on metals decreases with the increasing "electronegativeness" of the metals, which is in qualitative agreement with Hevesy's result for definite potentials. Aluminium and nickel, when boiled with pure neutral solutions of RaD and RaE, extracted RaE practically pure. A re-determination of the half-life period of RaE has been made and the value 4·87 days obtained, in confirmation of Thaller's value [Abstract 819 (1913)] of 4·85 days and of Fournier's value [see Abstract 316 (1926)] of 4·86 days. A. B. W.

2996. *Electrolysis of RaD and RaE.* **J. P. McHutchison.** (J. Phys. Chem. 30. pp. 1112–1115, Aug., 1926.)—V. Hevesy [see Abstract 1132 (1912) and Phil. Mag. 25. p. 390 (1913)] has shown that the extraction of radioactive elements by electrolysis of their solutions is possible when the e.m.f. employed is lower than the decomposition potential of their ordinary isotopes. Since no data were available as regards what extractions of RaD and RaE would be obtained when the e.m.f. and current density were arranged exactly as given for their isotopes, lead and bismuth, the present experiments were undertaken. The author concludes "that it is not possible to extract RaD or E on ordinary platinum electrodes from nitric acid solution with the electrolytic conditions required for the extraction of their isotopes, lead and bismuth respectively. Extraction becomes possible under these conditions if traces of lead or bismuth are present, but the active matter obtained on any one electrode is due to adsorption effects as well as to electrolytic decomposition. [See also Abstract 2207 (1926).] A. B. W.